

May 8, 1998 DRAFT

**C&SF RESTUDY ALTERNATIVE EVALUATION TEAM REPORT
ON THE
PLAN FORMULATION ALTERNATIVE 5**

Prepared by the C&SF Restudy Alternative Evaluation Team

Introduction

The Central and Southern Florida (C&SF) Project Restudy created an Alternative Evaluation Team (AET) for the purpose of evaluating the effects from a number of alternative plans, as a basis for developing the Comprehensive Plan for the C&SF Project. The objective of the AET evaluation process is to identify the plan (or plans) which best meets the regional restoration and sustainability goals set by the authorizing legislation for the C&SF Project, and the Conceptual Plan of the Governor's Commission for a Sustainable South Florida. The optimum components in a Comprehensive Plan are identified by means of an iterative evaluation process, whereby different combinations of these components are sequentially modeled and evaluated relative to a set of pre-determined performance measures. Components which substantially improve on base conditions, or which meet performance targets, are carried forward in the iterative modeling and evaluation process, while components which fail to perform well may be modified or rejected.

The AET is an ad hoc team, established by the Restudy for the specific purpose of evaluating a large number of alternative plans during a definitive planning process. The plan evaluation process is scheduled for September 1997 through April 1998. This report presents a summary of the conclusions of the fifth plan evaluation meeting of the AET, held April 1-2, 1998. At this meeting, the AET evaluated the Alternative 5 model simulation (summarized below). The core of this report is a set of evaluations conducted by ten subregional and issue subteams of the AET, relative to Alternative 5, and recommendations from these subteams and the full AET for improvements in performance required during subsequent plan simulations. This report also includes recommendations for improvements in the plan evaluation process, for incorporation in future evaluation cycles.

Methods

The AET is a multi-agency, multi-disciplinary team, consisting of about 30 members. The AET is divided into ten subregional and issue subteams, each with a chair or co-chairs (Kissimmee / Lake Okeechobee, Lake Okeechobee Service Area, Lower East Coast, Northern / Central Everglades, Southern Everglades, Estuaries and Bays, Big Cypress, Total Systems, ATLSS / Threatened and Endangered / Keystone Species, and Water Quality). During each evaluation cycle, each subteam has the lead responsibility for collecting all evaluations submitted to the AET from any non-AET source, which are applicable to the subregion and issues being

addressed by that team; additionally, each subteam performs its own evaluations. The subteams synthesize all evaluations into subteam reports to the full AET during each evaluation cycle.

Plan evaluations conducted by the subteams and the full AET are based on, (1) a set of pre-determined, hydrological performance measures, and (2) output from landscape-scale, ecological and water quality models. Each performance measure identifies specific hydrological targets, based on ecological, water supply, flood control and water quality objectives established for the C&SF Restudy. These hydrological targets have been defined in large part through the development of a suite of conceptual ecological models for the south Florida wetland landscapes, the draft Lower East Coast Regional Water Supply Plan, and the Lake Okeechobee Regulation Schedule Study. Performance measures may be added or deleted from the set used by the AET, based on recommendations from the subteams and approval by the full AET. Each alternative plan is evaluated based on the success of that plan in meeting the targets established by the performance measures. The hydrological performance of each plan is reported on the public web site during each evaluation cycle.

In addition to the performance measures, the AET may use output from four landscape scale models, the Across Trophic Level System Simulation model (ATLSS), the Everglades Landscape Model (ELM), the Everglades Water Quality Model (EWQM), and the Lake Okeechobee Water Quality Model (LOWQM). These models will be used to compare effects from alternative plans against either the current base (1995) or future "without project" base (2050). Summaries of output from these models, as it becomes available to the AET, will be reported in the AET evaluation reports.

Evaluations submitted by a subteam to the full AET, whether originating from the subteam or from an outside evaluator, are framed within the context of one or more performance measures. The full AET, during its meeting, synthesizes the subteam evaluations into a set of summary, "highlights" statements. These highlights statements are intended to describe the major strengths and weaknesses of the plan under current review, relative to the targets set by the performance measures. The highlights statements are provided to the Alternative Development Team (ADT) as a basis for designing the next alternative plan.

In addition to the highlights report, the AET prepares a written report of each evaluation cycle. The written reports include short narrative summaries from each subteam, a list of the performance measures used by the subteams during that evaluation cycle, and recommendations for future plans and to the evaluation process.

Evaluation of Alternative 5

Plan Components

The following components are those which were included in the Alternative 5 hydrologic simulation by the South Florida Water Management Model (SFWMM). Many of the components developed for Alternative 4 or earlier alternatives have not been modified and are included as part of Alternative 5. A more detailed description of the alternative can be found on

the Restudy web site (www.restudy.org), Comprehensive Plan Evaluation, Alternatives Description / Evaluation.

Component A5. A Storage Reservoir (20,000 acres at 10' maximum depth) north of Lake Okeechobee. Purpose: incorporate climate-based inflow forecasting to increase the utilization of the reservoir to provide additional flood protection, water supply and environmental enhancement. Operation revised.

Component B2. A Storage Reservoir (10,000 acres at 4' maximum depth) in the St. Lucie Basin. Purpose: to capture local runoff from C-44 for flood attenuation, water supply benefits including environmental water supply deliveries to the estuary, and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary.

Component C1. Environmental Water Supply Deliveries to the St. Lucie Estuary. Purpose: to provide freshwater flow to the St. Lucie Estuary to protect and restore more natural estuarine conditions.

Component D5. A Storage Reservoir (20,000 acres at 8' maximum depth) with Aquifer Storage and Recovery (22, 10-MGD wells) in the Caloosahatchee Basin. Purpose: to capture basin runoff and regulatory releases from Lake Okeechobee to provide water supply benefits, some flood attenuation and environmental water supply deliveries to the Caloosahatchee Estuary. Operated in conjunction with DDD5.

Component E5. Environmental Water Supply Deliveries to the Caloosahatchee Estuary (operational change only). Purpose: to provide freshwater deliveries to the Caloosahatchee Estuary to establish desirable salinity at locations of key estuarine biota. Operational target flow at S-79 revised.

Component F3. Current Lake Okeechobee Regulation Schedule (elimination of all except Zone A [emergency] regulatory releases to the St. Lucie and Caloosahatchee estuaries). Purpose: to implement operating criteria for Lake Okeechobee that includes flood control, water supply (including releases to the WCAs to meet estimated natural system needs) as well as lake littoral zone and estuary protection.

Component G5. A Storage Reservoir (one 20,000 acre compartment at 6' maximum depth for supplying agricultural irrigation demands and one 40,000 acre compartment at 6' maximum depth for supplying environmental demands) in the Everglades Agricultural Area with increased conveyance from Lake Okeechobee to the reservoir. Purpose: to improve timing of environmental deliveries to the WCAs including reducing damaging flood releases from the EAA to the WCAs, reduce Lake Okeechobee regulatory releases to estuaries, meet supplemental agricultural irrigation demands and increase flood protection within the EAA. Conveyance capacity of the Miami and North New River canals between Lake Okeechobee and the storage reservoirs is increased to convey additional Lake Okeechobee regulatory releases that would have otherwise been discharged to the Caloosahatchee and St. Lucie estuaries. As compared to Alternative 4, the reservoir was modified to operate Compartment 2 as a dry storage area with withdrawals being made down to 18" below ground level. It has also been subdivided into two

20,000-acre compartments to allow for more efficient use of the reservoir and for alternative uses of the compartments during dry times (i.e. agriculture).

Component H5. Everglades Rain-Driven Operations. Purpose: to improve timing and location of water depths in the WCAs and Everglades National Park. Operational change only.

Component I3. Improved Conveyance between Water Conservation Area 3B and Everglades National Park. Not included in Alternatives 4 or 5.

Component J1. Plug L-67A borrow canal (between S-151 and Modified Water Delivery Structures S-345s). Not included in Alternatives 2, 3, 4 or 5.

Component K4. Water Preserve Areas / L-8 Project. Purpose: to further reduce water supply restrictions in the Northern Palm Beach County Service Area by capturing more of the discharges from portions of the southern L-8, C-51 and C-17 basins in local aquifer storage and recovery facilities (25 MGD well clusters at Lake Mangonia) and route this water to the West Palm Beach Water Catchment Area. Intent is to increase regional water supply availability, provide pass through flow to enhance hydroperiods in Loxahatchee Slough and increase base flows to the Northwest Fork of the Loxahatchee River.

Component L3. Change Coastal Wellfields Operations in the Lower East Coast Service Area. Purpose: to shift demands from eastern wellfields inland to western facilities away from the saltwater interface to reduce impact of saltwater intrusion.

Component M4. Water Preserve Areas / Site 1 Impoundment (1,660 acres at 6' maximum depth) with Aquifer Storage and Recovery wells increased to 15, 5-MGD wells in Palm Beach County. Purpose: to increase regional water resources and supplement water deliveries to the Hillsboro Canal during the dry season.

Component N2. Water Conservation Area 2B Levee Seepage Management. Not included in Alternatives 4 or 5.

Component O4. Water Conservation Area 3A and 3B Levee Seepage Management. Purpose: to reduce seepage from WCAs 3A and 3B and to improve hydropatterns within the conservation areas by allowing higher water levels in the borrow canals and longer inundation durations within the marsh areas that are located east of the WCAs and west of US Highway 27. Seepage from the WCAs and marshes will be collected and directed south into the Central Lake Belt Storage Area. This will maintain flood protection and the separation of seepage water from urban runoff originating in the C-11 basin and separation of Lake Okeechobee water supply deliveries.

Component P2. North New River Diversion Canal and Treatment Facility. Not included in Alternatives 4 or 5.

Component Q5. Water Preserve Areas / Western C-11 Diversion Impoundment and Canal (1,600 acres of stormwater treatment area / impoundment and 2,500 cfs diversion canal) in

Broward County. Purpose: to divert untreated runoff from western C-11 that is presently discharged into WCA-3A through the C-11 Stormwater Treatment Area / Impoundment and then into the North Lake Belt Storage Area. Alternative 5 maintains the western C-11 Canal at elevation 3.0' NGVD in order to improve ground water conditions in the eastern C-11 Basin.

Component R4. Water Preserve Areas / C-9 Stormwater Treatment Area / Impoundment (2,500 acres at 4' maximum depth) in Broward County. Purpose: to provide treatment of water supply deliveries from the North Lake Belt Storage Area prior to deliveries to the C-9, C-6/C-7 and C-2/C-4 canals, ground water recharge within the basin and seepage control of WCA-3 and buffer areas to the west.

Component S5. Central Lake Belt Storage Area (5,200 acres with subterranean seepage barrier around the perimeter) in Miami-Dade County. Purpose: to receive and store excess water from WCAs 2B, 3A and 3B without ground water seepage losses in this highly transmissive region. The stored water will be provided based on priority to 1) Northeast Shark River Slough, 2) WCA-3B, 3) to supply flows to Biscayne Bay and 4) when available to meet Snapper Creek demands and to maintain Dade-Broward levee borrow canal at elevation 5.0' NGVD.

Component T1. C-4 Structure in Miami-Dade County. Purpose: to maintain higher water levels in the C-4 Canal to reduce seepage losses from the Pennsuco Wetlands and areas to the west of the structure located just downstream of the Dade-Broward Levee on C-4.

Component U4. Water Preserve Areas / Bird Drive Recharge Area (2,877 acres at 4' maximum depth) in Miami-Dade County. Purpose: to provide flood peak attenuation by capturing runoff from western C-4 Basin and pumping it to the Bird Drive Recharge Area, reduce seepage from the Everglades National Park buffer areas by increasing water table elevations east of Krome Avenue and enhance ground water recharge.

Component V2. L-31N Levee Improvements for Seepage Management in Miami-Dade County with additional reduction of seepage in the wet season. Purpose: to manage levee seepage along the eastern edge (L-31N) of Everglades National Park to eliminate losses to the east coast. An additional feature has been added to reduce all wet-season seepage/ground water flows to the east to help restore hydropatterns in Everglades National Park.

Component W2. Taylor Creek / Nubbin Slough Storage and Treatment Area (5,000 acre storage area at 10' maximum depth and 5,000 acre stormwater treatment area at 4' maximum depth) in Okeechobee and St. Lucie Counties. Purpose: to provide flood protection, water quality treatment, estuary protection and water supply benefits.

Component X3. Water Preserve Areas / C-17 Backpumping in North Palm Beach Service Area (550 acre stormwater treatment area at 4' maximum depth). Purpose: to increase regional water resources to reduce water supply restrictions in Northern Palm Beach County Service Area by providing additional flows from the C-17 Basin (which would otherwise be sent to tide) to the West Palm Beach Water Catchment Area and enhance hydroperiods in the Loxahatchee Slough.

Component Y3. Water Preserve Areas / C-51 Backpumping to Water Catchment Area in Palm Beach County (600 acre stormwater treatment area at 4' maximum depth). Purpose: to increase regional water resources to reduce water supply restrictions in Northern Palm Beach County Service Area by providing additional flows from the C-51 West Basin (which would otherwise be sent to tide) to the West Palm Beach Water Catchment Area and enhance hydroperiods in Loxahatchee Slough.

Component AA3. Additional S-345 Structures in L-67A in WCA-3B. Purpose: to improve conveyance to WCA-3B through the L-67 levee system to help in re-establishing NSM-like hydroperiods and hydropatterns in WCA-3B and Northeast Shark River Slough.

Component BB4. Dade-Broward Levee / Pennsuco Wetlands in Miami-Dade County. Purpose: to reduce seepage to the east from the Pennsuco Wetlands and southern WCA-3B, enhance hydroperiods in the Pennsucos and enhance recharge to Miami-Dade County's NW wellfield.

Component CC5. Broward County Secondary Canal System. Purpose: to increase pump capacity of existing facilities (from the 2050 Base) and construct additional canal and pump facilities for the Broward County Secondary Canal System to provide additional recharge to wellfields located in central and southern coastal Broward County, stabilize the saltwater interface and reduce discharges to tide.

Component DD5. Revised Holey Land Operation Plan (based on rain-driven operations) in Palm Beach County. Purpose: to improve timing and location of water depths within the Holey Land Wildlife Management Area based on rain-driven operations. Operational change only.

Component EE5. Modified Rotenberger Operation Plan (based on rain-driven operations) in Palm Beach County. Purpose: to improve timing and location of water depths within the Rotenberger Wildlife Management Area based on rain-driven operations. Operational change only.

Component FF4. Construction of S-356 A & B Structures and relocation of a portion of L-31N in Miami-Dade County. Purpose: to improve deliveries to Northeast Shark River Slough in Everglades National Park and reduce seepage to Lower East Coast Service Area 3.

Component GG4. Lake Okeechobee Aquifer Storage and Recovery (100, 10-MGD wells) along the lake peripheral levee. Purpose: utilize climate based operational rules for the aquifer storage and recovery wells to provide additional regional storage while reducing both evapotranspiration losses and the amount of land removed from current land use (e.g. agriculture) that would normally be associated with construction and operation of above-ground storage facilities (reservoirs); increase the lake's water storage capability to better meet regional water supply demands for agriculture, Lower East Coast urban areas, and the Everglades; manage a portion of regulatory releases from the lake primarily to improve Everglades hydropatterns, meet environmental targets within the WCAs and meet supplemental water supply demands of the Lower East Coast; reduce harmful regulatory discharges to the St. Lucie and Caloosahatchee estuaries; and maintain existing level of flood protection.

Component HH3. Operation Change of S-343 A and B (closed during the January to June time period) in Miami-Dade County. Purpose: to reduce the potential adverse effects on the nesting season of the Cape Sable seaside sparrow due to high water levels, the S-343 A and B structures will be closed during the January to June time period.

Component II3. Pump Station G-404 Modification in Palm Beach County. Purpose: to increase the capacity of the proposed Everglades Construction Project pump station G-404 from 1,000 cfs to 2,000 cfs to improve the hydropattern restoration in the northwest corner of WCA-3A and increase the amount of water available in the west-central region of WCA-3A to reduce dry out periods.

Component JJ3. Loxahatchee National Wildlife Refuge Rainfall-driven Operations. Not included in Alternatives 4 or 5.

Component KK4. Loxahatchee National Wildlife Refuge Internal Canal Structures. Purpose: to improve timing and location of water depths in the Refuge by keeping the borrow canal structures closed except to pass Stormwater Treatment Areas 1 East and 1 West outflow and water supply deliveries.

Component LL4. C-51 Regional Ground Water Aquifer Storage and Recovery (54 well clusters, total injection and recovery capacity is 170 MGD) in Palm Beach County. Purpose: to increase regional water resources by capturing and storing excess water during wet periods and recovering the water for utilization during dry periods.

Component MM4. Hillsboro Canal Basin Regional Ground Water Aquifer Storage and Recovery (22 well clusters, total injection and recovery capacity is 110 MGD) in Broward and Palm Beach counties. Purpose: to increase regional water resources by capturing and storing excess water during wet periods and recovering the water for utilization during dry periods.

Component NN3. North New River Regional Ground Water Aquifer Storage and Recovery. Not included in Alternatives 4 or 5.

Component OO4. Modification to South Dade Conveyance System in Southern Portion of L-31N and C-111. Purpose: to modify C-111 Canal operations (similar to the Test 7, Phase 1 criteria) to improve deliveries to Everglades National Park and decrease potential flood risk in the Lower East Coast Service Area 3.

Component PP3. Backpumping of the C-7 basin to the Central Lake Belt Storage System via the C-6 Canal. Not included in Alternatives 4 or 5.

Component QQ5. Decompartmentalization of Water Conservation Area 3. Purpose: to remove most flow obstructions to achieve unconstrained or passive flow between WCAs 3A and 3B and Northeast Shark River Slough and reestablish the ecologic and hydrologic connection between these areas.

Component RR4. Flow to Central Water Conservation Area 3A. Purpose: to increase depths and extend hydroperiods in central WCA-3A by relocating the S-140 pump station approximately eight miles south and increasing the capacity to 2,000 cfs.

Component SS4. Reroute Miami-Dade County Water Supply Deliveries. Purpose: to reroute water supply deliveries made to Miami-Dade County from the Miami and Tamiami canals and WCA-3 to the North New River Canal due to the backfilling of the Miami Canal as part of the decompartmentalization of WCA-3.

Component TT4. Decompartmentalization of Water Conservation Area 2. Not included in Alternatives 4 or 5.

Component UU5. Storage Reservoirs (23,782 acres at 8' maximum depth) in Martin and St. Lucie counties. Purpose: to capture local runoff from the C-23, 24, and Northfork and Southfork basins of the St. Lucie River Estuary for flood flow attenuation to the estuary, water supply benefits including environmental water supply deliveries to the estuary, and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary. The reservoirs were increased in size and reconfigured from the configuration presented in Alternative 4.

Component VV5. Palm Beach County Agricultural Reserve Reservoir (1,660 acres at 6' maximum depth) with Aquifer Storage and Recovery wells (15, 5-MGD wells). Purpose: to increase regional water resources in central and southern Palm Beach County by capturing and storing water currently discharged to tide to be used to maintain canal stages during the dry season.

Component WW5. C-111N Spreader Canal in Miami-Dade County. Purpose: to reduce wet season flows in C-111, improve deliveries to Model Lands and Southern Glades and decrease potential flood risk in the lower south Miami-Dade area. C-111N was extended east of Card Sound Road.

Component XX5. North Lake Belt Storage Area (4,500 acres with subterranean seepage barrier around the perimeter) in Miami-Dade County. Purpose: to increase regional water resources by capturing a greater portion of runoff from western C-6, western C-11 and C-9 basins in the enlarged storage area without ground water seepage losses in this highly transmissive region and without concerns of ground water contamination from untreated runoff. The stored water will be used to maintain stages during the dry season in the C-9, C-6, C-7, C-4 and C-2 canals.

Component YY4. Divert Water Conservation Area 2 (Broward County) flows to Central Lake Belt Storage in Miami-Dade County. Purpose: to capture excess water in WCA-2B to reduce stages above desired target levels and to divert water through improved L-37 and L-33 borrow canals to meet the following prioritized demands 1) North East Shark River Slough to meet targets, or 2) Central Lake Belt Storage Area.

Component ZZ5. Divert Water Conservation Area 3A and 3B flows to Central Lake Belt Storage Area. Purpose: to capture excess water above target stages in WCAs 3A and 3B and

divert it through modified structures at S-9 and S-31 to the Central Lake Belt Storage Area via the L-33 borrow canal.

Component AAA5. Lower East Coast Utility Water Conservation. Purpose: to reduce the dependency of the lower east coast urban areas on Lake Okeechobee and the WCAs with an anticipated increase in water availability to meet environmental demands.

Component BBB5. Miami-Dade County Reuse. Purpose: to augment water supply to the South Biscayne Bay and Coastal Wetlands Enhancement Project to restore overland flow in the coastal area, recharge ground water to enhance ground water discharge to Biscayne Bay and provide saltwater intrusion benefits to the southern part of Miami-Dade County through the use of superiorly treated reclaimed water from the South District Wastewater Treatment Plant.

Component CCC5. Big Cypress / L-28 Interceptor Modifications. Purpose: to alleviate drainage in Northeast Big Cypress, Kissimmee Billy and Mullet Slough area, ensure applicable water quality treatment and restore sheetflow to wetland areas in northeast Big Cypress.

Component DDD5. Caloosahatchee Backpumping with Stormwater Treatment Area. Purpose: to increase the regional water resources by capturing excess C-43 Basin runoff and diverting it into Lake Okeechobee after treatment through a stormwater treatment area.

Component EEE5. Flows to Eastern Water Conservation Area 3B from Central Lake Belt Storage Area. Purpose: to capture excess surface water and seepage from WCAs 2B, 3A and 3B, store the excess in the Central Lake Belt Storage Area and deliver it to eastern WCA-3B during dryouts.

Component FFF5. Biscayne Bay Coastal Canals. Purpose: to maintain higher stages in the C-102 and C-103 canals for urban and environmental water supply. A proposed borrow canal will interconnect the downstream reaches of the C-102 and C-103 canals.

Alternative 5 Highlights

Top 10 AET Highlights

1. LOSA – Reduce severity of 81-82 drought event to 7 months duration. Do not further damage the lake.
2. Cape Sable seaside sparrow – Eastern and central regions are too wet during the dry season. Return to Alternative 4 conditions, (take out L-28?).
3. Estuaries – Eliminate the 2 lake regulation releases in Alternative 5.
4. Northern Everglades – Alleviate high water depths in eastern WCA 3A/B.
 - Consider structural integrity of levees.
 - Eliminate 94-95 pooled > NSM depths in southern 3A.

- Further improve high water situation in southern 2A, and low water situation in 2B.
5. Southern Everglades – Increase dry season flows to NESRS to (evaluate seasonality): increase hydroperiod (needs long periods, 18 years in some instances, of continuous inundation) in NESRS, mid SRS, Rockland marl; and increase water depth by an average of 0.5 ft.
 - Increase dry season water flows via C-111 to increase hydroperiod in mid-Perrine marl marsh one month.
 - Move high water out of C-111 Perrine marl marsh, region 4 (in part) model sheetflow through area (OPE?).
 6. LEC – Modify conservation component based on results of meeting next week.
 - Raise the low water levels in C-10, C-12 basins.
 - Use an alternative storage component to ASR/model with it in also (debate tomorrow at Restudy meeting).
 - Model reuse components proposed by Eric Hughes.
 7. St Lucie Estuary – Reduce high flow events from local run-off (all basins).
 8. Increase surface water and ground water flows to Biscayne Bay without using reuse (and with reuse, and reuse for agricultural irrigation).
 9. Big Cypress – modify L-28 interceptor design (too wet at top end in Alternative 5).

A. TOTAL SYSTEM HIGHLIGHTS

Performance Indicator: Mean Annual Overland Flow.

Goal/Target: Restore general overland flow patterns as indicated by NSM.

Performance: Dramatic improvements over the 2050 Base can be seen, particularly in WCA-3A and Shark River Slough. Over Alternative 4, Alternative 5 improves flow patterns and velocities along the eastern boundary of WCA-3A and WCA-3B. Flows through WCA-3A on the upstream side of L-67A are not as good as Alternative 4, but are better than Alternative 3. Instead of pushing too much water through WCA-3B, Alternative 5 lets it stack up above L-67. WCA-3B is improved, but there is an effect now in WCA-3A. Like Alternative 4, Alternative 5 shows greater than NSM velocities along the eastern boundary of Everglades National Park and Shark River Slough but Alternative 5 flow patterns are still better than Alternative 3, particularly flows through northeastern WCA-3A and WCA-3B.

Improvement Needed: Reduce excessive flow volumes along eastern WCA-3A and along the eastern boundary of the park.

Performance Indicator: Hydroperiod Distribution Maps and Charts.

Goal/Target: The general goal is to match NSM patterns.

Performance: NSM for the dry year 1989 predicts several long-hydroperiod areas (hydroperiod class 330-365 days) connected by intermediate hydroperiod class wetlands (300-330 days) would persist even during dry years. Although the locations are not exactly like NSM, Alternative 5 does show a better interlocking pattern of pools and connecting wetlands. In Alternative 5 there

are more 330-360 day hydroperiods, more than NSM predicts, and fewer 300-330 day hydroperiod wetlands.

Improvement Needed: Reduce the large number of cells throughout the system with hydroperiods exceeding NSM by more than 30 days. New overshoots in the Native American lands north of Mullet Slough are a concern.

Performance Indicator: Hydroperiod Improvement.

Goal/Target: Hydroperiods in a majority of acres in each area should improve 30 days or more compared to NSM.

Performance: Compared to the 2050 Base, for the WCAs, Everglades National Park, Rotenberger, Holey Land, and Pennsuco, nearly 500,000 acres were improved. This was a small (46,000 acres) reduction from Alternative 4. There were shortened hydroperiods in 23,000 more acres and 33,000 fewer acres exceeded NSM. Attempts to match NSM tend to cause either overshooting NSM or shorter hydroperiods in as large, or larger, areas than areas improved. For example, in the Loxahatchee National Wildlife Refuge, 36,000 acres of improved hydroperiods can be compared to the 95,000 acres experiencing extreme hydroperiods (41,000 acres exceeding NSM and 54,000 acres with shorter hydroperiods.) The small percentage gains in WCA-2A and northern WCA-3A should be compared to additional areas experiencing extreme hydroperiods in those same areas. Half of the improvements gained in Alternative 4 were lost in southern WCA-3A and WCA-3B and extreme conditions were increased there, too.

Improvement Needed: Reduce the extreme hydroperiods throughout the system without losing the hydroperiod improvements.

Performance Indicator: Hydroperiod Matches.

Goal/Target: NSM matches for 100% of cells.

Performance: There was a 2% drop in the number of cells matching NSM for the WCAs for Alternative 5 compared to Alternative 4 (79% from 81%). In WCA-2B, southern WCA-3A, and Holey Land, Alternative 5 resulted in % matches lower than the 2050 Base. For most of the other areas except for WCA-3B and the park, which received the most benefits, improvements in hydroperiod matches are in the single digits over the 2050 Base. The Alternative Development Team was asked to improve matches for WCA-2B, which had the fewest matches of any area except for Pennsuco, and they did: matches in the WCA (46%) are 10% better than over Alternative 4 (36%). Slight improvements in matches were also seen in northern WCA-3A (5%), WCA-3B (4%), and Everglades National Park (2%). There are fewer matches in Loxahatchee (-4%) and particularly Holey Land (-14%). Alternative 5 improved dry year conditions (1989) in Shark River Slough. Compared to 1995 Base, hydroperiods in Alternative 5 are improved for all areas except WCA-2B. Compared to 2050 Base, hydroperiods for Alternative 5 are improved in all areas except WCA-2B, southern WCA-3A, and Holey Land.

Improvement Needed: Continue improvements made in dry year pools and patterns. Continue improvements to long hydroperiod areas, including the long hydroperiod sloughs (particularly Shark River Slough) in the park. Raise % matches in WCA-3B (67%), Holey Land (50%) and Pennsuco (25%); they have the lowest scores.

Performance Indicator: Ponding Depth Matches.

Goal/Target: 100% matching NSM.

Performance: The % of the WCA system matching mean NSM ponding depths went down. Mostly, mean depths were higher. For this alternative, ponding depths were considered less important than hydroperiod, so % matches were allowed to seek their own level. Consequently, matches in WCA-2B and southern WCA-3A went down. WCA-2B is still a 36% improvement over 2050 Base. Southern WCA-3A now has 20% fewer matches than 2050 Base. Other areas were only affected a few percentage points or were even improved.

Improvement Needed: Southern WCA-3A may need some attention, depending on the priorities decided upon by the Alternative Evaluation Team as a whole.

B. KISSIMMEE / LAKE OKEECHOBEE SUBREGION

Performance Measure: Number of stage events >17 ft.

Indicator used: Daily stage hydrographs for Lake Okeechobee.

Target: No events.

Comments: Under Alternative 5 there were three such events. This is comparable to the results for Alternative 4 (two events) and Alternative 3 (three events), and is an improvement over both the 2050 Base (five events) and the 1995 Base (six events).

Recommendation: Maintain this low frequency.

Performance Measure: Number of stage events >15 ft lasting > 6 months.

Indicator and Measure used: Daily stage hydrographs and similarity in duration of stage events >15 ft.

Target: No events.

Comments: Under Alternative 5 there were three such events. This is comparable to the results for Alternative 4 (two events) and Alternative 3 (three events), and is an improvement over both the 2050 Base (six events) and the 1995 Base (seven events). The median duration of >15 ft events remains low (~30 days) under Alternative 5. This also is a positive result.

Recommendation: Maintain the low frequency and duration of >15 ft events.

Performance Measure: Number of stage events <12 ft lasting >6 months.

Indicator and Measure used: Daily stage hydrographs and similarity in duration of stage events <12 ft.

Target: No events.

Comments: Under Alternative 5 there were three such events. This is an improvement over all previous alternatives, and matches the frequency under the 1995 Base. The median duration of <12 ft events is very low (~30 days) under Alternative 5. This also is a positive result.

Recommendation: Maintain the low frequency and duration of <12 ft events.

Performance Measure: Number of stage events <11 ft.

Indicator used: Daily stage hydrographs for Lake Okeechobee.

Target: No events.

Comments: Under Alternative 5 there were three such events. This is a dramatic improvement over all previous alternatives and base conditions (12 events for 2050 Base, eight for 1995 Base, six for Alternative 3, and eight for Alternative 4). The median duration of <11 ft events also is low (~25 days) under this alternative.

Recommendation: Maintain the low frequency and duration of <11 ft events.

Overall Conclusion: Alternative 5 represents the best, and most balanced, alternative considered to date from the standpoint of preventing harmful high and low water levels in Lake Okeechobee.

C. LAKE OKEECHOBEE SERVICE AREA

Performance Measures: Frequency of Water Restrictions for the 1965 – 1995 Simulation Period in the Lake Okeechobee Service Area, Monthly Supply-Side Management Results.

Goal: Total number of water restriction events (years with restrictions) should be three or less in the simulation period to indicate that the goal of meeting demands in a 1-in-10 year drought is being met.

Performance: In Alternative 5 there were six years when water restriction events occurred. Performance is close to meeting the goal that there be no more than three years with restrictions. This is because in three of the years the restrictions were in effect for only one or two months and involved small supply-side management cutback volumes. In water year 1974 there was one month of restrictions involving 3,000 acre feet. Comparable figures for the other two water years with minor restrictions are, for 1978, two contiguous months and 28,000 acre feet and for 1991, two non-contiguous months and 25,000 acre feet. In contrast the three remaining years with water restrictions (1981, 1982 and 1989) involve large supply-side management cutback volumes of over 200,000 to over 500,000 acre feet. The 1981 to 1982 period, which encompasses 16 continuous months of shortages with over 775,000 acre-feet of supply-side management cutback volumes, is of particular concern.

Improvement Needed: The focus of additional efforts should be the reduction in the severity of the 1981 to 1982 event.

Performance Measures: Everglades Agricultural Area (EAA) Water Budget (Runoff backpumped to Lake Okeechobee).

Goal: Maintain existing levels of flood protection. Backpumping to Lake Okeechobee occurs whenever water levels in the EAA indicate a threat of flooding may be developing. Levels of backpumping less than or as small as those in the 1995 Base are, therefore, indicative that flood protection is being maintained. A more discerning performance measure is still being developed.

Performance: There is no indicated problem. Average annual backpumping from the EAA to Lake Okeechobee in Alternative 5 is only about 30,000 acre feet over the 31-year period.

Improvement Needed: None.

D. LOWER EAST COAST

WATER SUPPLY:

Performance measure: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for the North Palm Beach Service Area and Service Area 1.

Goal: Reduce the frequency of local and Lake Okeechobee water restriction events to no more than three events for the 31-year period of record to meet a 1-in-10 level of certainty.

Performance: There are no indicated problems.

Recommendation: Alternative methods to achieve the same level of water supply should be investigated. The continued increased reliance on aquifer storage and recovery may undermine the feasibility of the plan.

Performance measure: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for Service Area 2.

Goal: Reduce the frequency of local and Lake Okeechobee water restriction events to meet a 1-in-10 level of certainty (no more than three events for the 31-year period of record).

Performance: The frequency of events caused by Lake Okeechobee decreases in Alternative 5 when compared to Alternative 4. There are three cutbacks due to Lake Okeechobee levels. Twelve shortage events for the period of record are caused by local ground water levels at trigger wells. The cutbacks occur near Hollywood and Ft Lauderdale Airport, the C-10 and C-12 basins. Moving Hollywood's pumpages has helped reduce the number of local events, but has not solved the problem of low ground water levels in the C-10 Basin. Moving C-9 water into the C-10 Basin has significantly reduced the number of locally triggered events. Reducing public water supply demand through conservation has not affected the low ground water levels near Hollywood and Ft Lauderdale Airport.

Improvement needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to a 1-in-10 level of certainty (no more than three events for the period of record).

Recommendation: Moving local wellfields for public water supply did not reduce the number of locally triggered cutbacks at Hollywood. Other causes of low ground water levels should be determined and modified to alleviate the number of cutbacks in this basin. Moving water east on the C-9 and connecting it to the regional system has helped and should continue. Moving additional water north to the C-10 to augment recharge has also helped to reduce the number of water supply cutbacks in the Hollywood trigger. An additional source of water to the C-10 is the existing Hollywood wastewater treatment plant, 50 MGD. The Ft Lauderdale Airport trigger may be affected by the surficial and ground pumping at the Florida Power and Light facility. Maybe these pumpages could be reduced or relocated to reduce the potential impact on the saltwater front. Deliveries to the environment could be reduced in order to ensure adequate levels are maintained in Lake Okeechobee to minimize the high number of water supply cutbacks to the Lower East Coast Service Area. In addition, the secondary canal recharge network could be augmented by the North County Regional Wastewater facility. It could provide 100 MGD to augment aquifer recharge via the WCA-2, C-3.

Performance measure: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for Service Area 3.

Goal: Reduce the frequency of local and Lake Okeechobee water restriction events to meet a 1-in-10 level of certainty (no more than three events for the 31-year period of record).

Performance: Two shortage events for the period of record are caused by local trigger wells. The well causing problems in Service Area 3 is Taylor (five times). Alternative 5 has reduced the water supply cutbacks due to Homestead to zero. The Taylor trigger may need to be reexamined or removed since it is not influenced by public water supply pumpages. In addition, there are three Phase 1 Lake Okeechobee triggered events for Service Area 3.

Improvement needed: Reduce number of local ground water and Lake Okeechobee triggered cutbacks to a 1-in-10 level of certainty (no more than three events for the period of record).

Recommendation: Additional mounding of ground water or increasing ground water seepage in south Miami-Dade County would help. Seepage from L-31N could be increased during the wet season to raise ground water levels. Deliveries to the environment could be reduced in order to

ensure adequate levels are maintained in Lake Okeechobee to minimize the number of water supply cutbacks to the Lower East Coast Service Area.

CANAL LEVELS:

Performance measure: % of time Canal Stage less than Saltwater intrusion Criteria and Occurrences greater than one Week for North Palm Beach Service Area, Service Areas 1, 2, and 3.

Goal: Reduce amount of time and number of occurrences the canal does not meet saltwater intrusion criteria to zero.

Performance: All canal levels meet or exceed the saltwater intrusion criteria. The one exception is the C-6, which fails to meet the criteria 1% of the time.

Performance indicator: Mean wet/dry Season Flows to Pond Apple Slough through C-11@S-13 for the 31-year simulation.

Goal: Provide enough water to prevent saltwater intrusion of Pond Apple Slough. Flows should be greater than 1995 Base flows and flows should be greater in the wet season.

Performance: Flows over S-13 are reduced by half diminishing the water supplied to the Pond Apple Slough. Rehydration of the slough is joint project by the South Florida Water Management District and Broward County Department of Natural Resource Protection.

Improvement Needed: More flows need to be sent east in C-11 and discharged over the S-13 to the slough.

Recommendation: Modify operation of C-11 Reservoir to provide more flows east.

Performance indicator: Stage duration curves for C-100A, C-100B, C-102N, C-103, C-103S, C-102, and C-1.

Performance: Many of the south Miami-Dade County canal water levels have shown great improvement in Alternative 5. Maintaining C-102, C-103, and C-1 water levels from reuse water from the South District Wastewater Treatment facility has been achieved. In addition, it has alleviated the locally triggered water supply cutbacks at the Homestead well.

Improvement needed: Meet or exceed the 1995 Base by another method other than use of reuse water. Altering seepage from L-31N to allow seepage in the wet season may also provide enough flows to the canals, Biscayne Bay and the public wellfields.

RESERVOIRS:

Performance indicator: Stage duration curves for C-11 Reservoir.

Performance: It stays a little wetter longer than Alternatives 4.

Recommendation: Send more water east for Pond Apple Slough.

Performance indicator: Stage duration curves for C-9 Reservoir.

Performance: The reservoir is much drier when compared to Alternative 3 and a little wetter than Alternative 4.

Performance indicator: Stage duration curves for North Lakebelt Reservoir.

Performance: The reservoir operates very well. The stage duration curve is high most of the time and it is able to supply water to meet saltwater intrusion criteria on the C-9.

Recommendation: Send additional supplies east and route north to the C-10.

Performance indicator: Stage duration curves for Bird Drive Reservoir.

Performance: Operation of this impoundment needs to be reexamined and/or more water needs to be routed from the regional system to hold consistently higher levels in these canals. The stage duration curve exceeds ground elevation only 7% of the time, almost the same as alternatives 3 and 4. Water quality concerns have been addressed by directing flows from urban areas away from the reservoir.

Improvement needed: Need method to determine if component effective.

Performance indicator: Stage duration curves for Central Lakebelt Reservoir.

Performance: The Central Lakebelt Storage described in Alternative 5 has many demands on it, but operates fairly well. Water levels are above ground over 60% of the time. The majority of the water is received from the WCA seepage control and is pumped to Northeast Shark River Slough. Using the water to meet natural area demands may be inefficient because the improvement to the slough is minimal due to the limits of the quantity of water stored in the reservoir.

Improvement needed: Need to correct how component operates so more water is stored in the reservoir to meet local demands.

Recommendation: A more efficient use of the water would be to use it to maintain stages in the Dade-Broward Levee Canal, enhance supplies to the South Dade Conveyance System or improve dry season flows to Biscayne Bay. Flows to Northeast Shark River Slough should come directly from WCA-2B and not be stored in the Central Lakebelt Reservoir.

DISCHARGES TO TIDE:

Performance indicator: Mean Annual Surface Flows Discharge to Tide from the Lower East Coast Service Area for the simulation period.

Performance: For Alternative 5, there is a trend from north to south of slight increases in the amount of water discharged to tide when compared to Alternative 4.

WATER DELIVERIES:

Performance indicator: Average Annual Regional Water Supply Deliveries to Lower East Coast Service Area for the period of record and for the five drought years.

Performance: The volume of water supplied on average has increased when compared to the 1995 Base, 2050 Base and Alternative 3 for Service Area 1 by about 55%, increases for Service Area 2 by 200%, and remains fairly constant for Service Area 3. Much of the increase in deliveries is due to increased reliance on ASR components and reservoirs to supply water. There is some concern over the viability of either of these options to supply water to the levels predicted in the model. Exceeding the NSM targets for many of the cells in Everglades National Park indicate that there is water available in the regional system that could be used instead of water from ASR wells. During drought events, deliveries have declined for Alternative 5 when compared to Alternative 4, and are approximately the same as the 1995 Base and 2050 Base. Service Area 1 and in some part Service Area 2 are dependent on the success of ASR for deliveries from the regional system. On average, the Lower East Coast Service Areas have gained some self-sufficiency, but they are still dependent on the regional system during drought events. Maintaining the storage areas in the regional system is the key to overcoming droughts in the Lower East Coast Service Area.

Improvement needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to a 1-in-10 level of certainty (no more than three events for the period of record).

Recommendations: Reduce the dependence on ASR and in-ground reservoirs and increase other types of storage in the regional system.

FLOOD PROTECTION:

Performance measure: End of month stage duration curves in selected cells in south Miami-Dade.

Performance: Significant progress was made in Alternative 4 towards increased flood protection, some of which was lost in Alternative 5. Three cells are at an increased risk to flooding. For R17C27, R12C28, R10C25, and R20C27 the stage duration curve for Alternative 5 meets the 83-93 target. There are no threats of flooding apparent. For R15C26 the stage duration curve is about a half a foot above the 1983-1993 target line and is also above the 1995 Base. However, for this cell the water levels are within the two-foot root zone only 15% of the time. For R13C25 the stage duration curve is comparable to Alternative 4, but still a half a foot above the 1983-1993 target and the 1995 Base. The water levels are within the two-foot root zone 44% of the time, which unacceptable. For R19C27 the stage duration curve for Alternative 5 is higher than Alternative 4 and just 4-5 inches above the 1983-1993 target. The two-foot root zone is saturation 73% of the time, which is also unacceptable.

Improvement needed: Meet 1983-1993 target line.

Recommendation: Increase flood protection in R15C26, R13C25, R19C27.

E. NORTHERN AND CENTRAL EVERGLADES

HOLEY LAND WILDLIFE MANAGEMENT AREA:

Performance Measure: Inundation Duration (Indicator Region 29).

Planning Targets: Match NSM #, mean duration and % of time.

☺**Evaluation:** Alternative 5 has 26 inundation events averaging 55 weeks in length for a total of 88% of time. This is similar to the 1995 Base (27 events averaging 52 weeks; 88% of time) and is slightly drier than NSM (24 events averaging 60 weeks; 90% of time). Performance is similar to alternatives 3 and 4 and much improved over the wetter 2050 Base.

Performance Measure: Extreme High Water (Indicator Region 29).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 1.5 ft depth.

☺**Evaluation:** Alternative 5 satisfactorily meets performance targets. Depths exceeded 1.5 ft 8% of time, which is less than NSM's 14%. Alternative 5 exceeded 1.75 ft only about 3% of the time. Although Alternative 5 has more high water events than NSM (32 vs. 19), they are of much shorter duration (average of four vs. 12 weeks).

Performance Measure: Extreme Low Water (Indicator Region 29).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺**Evaluation:** Alternative 5 satisfactorily meets performance targets for avoidance of low water extremes. Drying to more than 1.0 ft below ground occurred on nine occasions averaging four

weeks duration, for a total of 2% of time. This is similar to the 2050 Base and an improvement over Alternative 3 (13 events; average four weeks; 3% of time) and Alternative 4 (ten events; average four weeks; 3% of time).

Recommendation: Maintain the features responsible for this performance.

ROTENBERGER WILDLIFE MANAGEMENT AREA:

Performance Measure: Inundation Duration (Indicator Region 28).

Planning Targets: Match NSM #, mean duration and % of time.

☺**Evaluation:** Alternative 5 has 40 inundation events averaging 33 weeks duration for a total of 82% of time. The % inundation is not as good a match for NSM as in Alternative 3 or Alternative 4; however the number and duration of inundation events is more similar to NSM. There is substantial improvement over both the drier 1995 Base and the wetter 2050 Base.

Performance Measure: Extreme High Water (Indicator Region 28).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 1.5 ft depth.

☺**Evaluation:** Alternative 5 has zero events over 1.5 ft; this meets all performance targets for avoidance of prolonged high water that would promote cattail proliferation and flood tree islands.

Performance Measure: Extreme Low Water (Indicator Region 28).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺**Evaluation:** Alternative 5 shows much improvement in meeting performance targets for avoidance of low water extremes that promote peat oxidation and create risk of fires. Drying to more than 1.0 ft below ground occurred on 15 occasions averaging four weeks duration for a total of 4% of time. This is somewhat improved over the 2050 Base (5% of time) and much improved over the 1995 Base (19% of time) and alternatives 3 and 4 (8% of time). Although there are four more dry-downs than in NSM, the mean duration of these events and the total % is less than NSM.

Recommendation: Maintain the features responsible for this performance.

LOXAHATCHEE NATIONAL WILDLIFE REFUGE:

Performance Measure: Mean Hydroperiod Matches with NSM for Total Area and Inundation Duration (Indicator Regions 26 & 27).

Planning Targets: Match NSM #, mean duration and % of time.

☺**Evaluation:** 80.7% of the area matched NSM hydroperiods in Alternative 5. This is similar to the 1995 Base (80.7%), greater than the 2050 Base (77.2%), but less NSM-like than either Alternative 3 (94.7%) or Alternative 4 (84.2%). Alternative 5 hydroperiods exceed NSM in the south (Indicator Region 26), but are similar to NSM in the north (Indicator Region 27). The best overall NSM “alternative” match is still Alternative 3. Both Alternative 4 and Alternative 5 more closely match the 1995 Base than Alternative 3.

Performance Measure: Extreme High Water (Indicator Region 26 & 27).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

☹️**Performance:** While high water criterion is exceeded only once in northern Loxahatchee National Wildlife Refuge, it is exceeded 28 times for an average duration of 14 weeks in southern LNWR. Depths exceed three feet approximately 8% of the time, which is slightly less than the 1995 Base, slightly more than the 2050 Base and much more than Alternative 3.

Performance Measure: Extreme Low Water (Indicator Region 26 & 27).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺️**Evaluation:** Meets all criteria.

Improvements needed: If NSM patterns are desired there is a need to reduce depths in the southern part of the Loxahatchee National Wildlife Refuge.

WCA-2A:

Performance Measure: Mean Hydroperiod Matches with NSM for Total Area and Inundation Duration (Indicator Region 24 and 25).

Planning Targets: Match NSM #, mean duration and % of time.

☹️ ☹️**Evaluation:** Alternative 5 hydroperiods are similar to Alternative 4 for northern (Indicator Region 25) and southern (Indicator Region 24) WCA-2A. While the south has NSM-like conditions, the north stays inundated for 98% of the year with only eight events averaging 198 weeks compared to NSM with 22 events averaging 67 weeks for an average annual hydroperiod of 92%.

Performance Measure: Timing of Depth Variations (Indicator Region 24 & 25).

Planning Targets: Match NSM timing of peaks and pattern of variability.

☹️**Evaluation:** Temporal variation of mean weekly stages in Alternative 5 is similar to Alternative 4. Wet season depths in northern WCA-2A (Indicator Region 25) peak earlier than NSM and dry season depths exceed NSM by about 0.3 – 0.5 ft, whereas Alternative 3 and the bases are similar to NSM.

Performance Measure: Extreme High Water (Indicator Region 24 & 25).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

☹️**Performance:** Alternative 5 has more high water events in both northern and southern areas than NSM (four events in the north, average four weeks duration; nine events in the south, average five weeks duration). These frequencies exceed NSM targets of zero. This is worse than the 1995 and 2050 bases and Alternative 3 but slightly better than Alternative 4.

Improvement needed: Decrease extreme high water depths, especially in southern WCA-2A. Decrease hydroperiod in northern WCA-2A.

Performance Measure: Extreme Low Water (Indicator Region 24 and 25).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☹️**Evaluation:** Northern WCA-2A has only one low water event. Southern WCA-2A is similar to NSM. Alternative 5 had more events than Alternative 4 but it is improved over both base cases.

WCA-2B:

Performance Measure: Inundation Duration (Indicator Region 23).

Planning Targets: Match NSM #, mean duration and % of time.

☹️**Performance:** Hydroperiods are 80% compared to 95% for NSM. This is not as NSM-like as the 2050 or 1995 bases but is improved over Alternative 4 (70%).

Performance Measure: Extreme High Water (Indicator Region 23).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

😊**Evaluation:** Alternative 5 has the best performance so far with only 3% of time above 2.5 ft. The NSM target is 0%. This is much better than the 1995 and 2050 bases and slightly better than Alternative 4 (4%).

Performance Measure: Extreme Low Water (Indicator Region 23).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☹️**Performance:** Depths in WCA-2B are more than 1.0 ft below ground 7% of time. This is slightly worse than the 2050 and 1995 bases but better than Alternative 4 (11%). The NSM target is 1%.

Improvements needed: Decrease extreme low water events if possible.

NORTHWEST WCA-3A (north of Alligator Alley; west of Miami Canal):

Performance Measure: Inundation Duration (Indicator Region 20 & 22).

Planning Targets: Match NSM #, mean duration and % of time.

😊**Evaluation:** Alternative 5 is very similar to NSM in Indicator Region 22 (95% inundation vs. NSM 94%), but a little drier in Indicator Region 20 (91% vs. NSM 94%). Performance is marginally improved over alternatives 3 and 4, definitely improved over the 2050 Base (88% inundation in Region 20; 92% in Region 22), and dramatically better than the 1995 Base (81% in Region 20; 76% in Region 22).

Performance Measure: Extreme High Water (Indicator Region 20 & 22).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

😊**Evaluation:** Alternative 5 has zero high water events in Region 22 (vs. NSM's one event), and two events (1% of time) in Region 20 (vs. NSM zero events). This is slightly worse than Alternatives 3 and 4 (zero events in both regions) and worse than the 1995 and 2050 bases which also have zero events in Region 22 and Region 20.

Performance Measure: Extreme Low Water (Indicator Region 20 & 22).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

😊**Evaluation:** Alternative 5 is similar to NSM in % of time with depths less than 1.0 ft below ground (2% for Region 20 = NSM 2%; 1% for Region 22 = NSM 1%). Performance is better than the 2050 Base (4% low water, both regions) and much better than the 1995 Base (7% in Region 20; 12% in Region 22) and better than both alternatives 3 and 4 (2-3%). Mean duration of dry-downs below -1.0 ft averages five weeks, which is longer than desirable for protection of

peat soils. However, current performance may be the best that can be achieved without requiring prolonged inundation that could promote cattail proliferation in this region.

Recommendation: Maintain this performance.

NORTHEAST WCA-3A (north of Alligator Alley; east of Miami Canal):

Performance Measure: Inundation Duration (Indicator Region 21).

Planning Targets: Match NSM #, mean duration and % of time.

☺**Performance:** Alternative 5 hydroperiod matches NSM in this region.

Performance Measure: Extreme High Water (Indicator Region 21).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.0 ft depth.

☺**Performance:** Alternative 5 has seven high water events averaging nine weeks duration for 4% of total time. This performance is substantially worse than alternatives 3 (two events; 1% of time) and 4 (five events; 2% of time), as well as the 1995 and 2050 bases (each with two events; 1% of time). It does not meet the NSM target (three events near 0% of time).

Recommendation: Reduce frequency of extreme high water without increasing frequency of dry-outs.

Performance Measure: Extreme Low Water (Indicator Region 21).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺☺**Performance:** Alternative 5 dries out more than 1.0 ft below ground on 15 occasions averaging six weeks duration (6% of time). This meets NSM criteria and is an improvement over Alternative 4 (17 events averaging seven weeks; 8% of time). However, performance is not as good as Alternative 3 (11 events; average five weeks; 3% of time) or the 2050 Base (11 events; average seven weeks; 5% of time). Although performance meets the NSM target, this frequency of dry-downs may be likely to lead to further loss of peat soils.

EAST WCA-3A (south of Alligator Alley; east of Miami Canal):

Performance Measure: Inundation Duration (Indicator Region 19).

Planning Targets: Match NSM #, mean duration and % of time.

☺**Evaluation:** Alternative 5 (95% inundation) is not as good a match for NSM (89%) as is Alternative 4 (91%) but is a better match than Alternative 3 (97%). Alternative 4 is a better match for NSM-like hydroperiods.

Performance Measure: Extreme High Water (Indicator Region 19).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

☺**Performance:** Still way too wet. Alternative 5 has 31 events averaging 16 weeks for 31% of time. This is more than twice the frequency of high water in alternatives 3 and 4, and nearly three times that of 2050 Base (23 events; average eight weeks; 11% of time). It nonetheless is better than the 1995 Base. Note that the pattern of inundation in Alternative 5 is similar to that in southern WCA-3A (Indicator Region 14, 36% high water) and southern Loxahatchee National Wildlife Refuge (Indicator Region 26) under the 1995 Base. Predicted flooding during the high water of 1995 actually exceeds that of the 1995 Base.

Recommendation: The stage duration curve is too steep and the area deviates greatly from NSM-like marsh hydrology. Reduce extreme high water.

Performance Measure: Extreme Low Water (Indicator Region 19).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺**Evaluation:** Alternative 5 has four low water events averaging two weeks duration for 1% of total time. This frequency meets the NSM-based target of less than eight events of four weeks duration (2%), and is also better than Alternative 4.

WCA-3A (south of Alligator Alley; west of Miami Canal):

Performance Measure: Inundation Duration (Indicator Region 14, 17 and 18).

Planning Targets: Match NSM* in #, mean duration and % of time. (*NSM targets for Indicator Region 17 were adjusted using the average for indicator regions 14 and 18.)

☺☺ **Evaluation:** Southern WCA-3A (Indicator Region 14) is inundated 96% of time; this matches NSM (95%), is similar to Alternative 3 (96%), Alternative 4 (94%), and the 2050 Base (96%), and is an improvement over the 1995 Base (99%). South central WCA-3A (Indicator Region 17) is inundated 96% of time; this is similar to the 1995 Base (95%) and Alternative 4 (95%), and slightly wetter than the adjusted NSM hydroperiod target of 94%. North central WCA-3A (Indicator Region 18) is inundated 97% of time; 5% longer than NSM and 6% longer than the 1995 and 2050 bases. Overall, southern WCA-3A may be slightly wetter than is desirable, especially in Indicator Region 18 near Alligator Alley.

Performance Measure: Extreme High Water (Indicator Region 14, 17 and 18).

Planning Targets: (1) minimize and (2) be less than or equal to NSM* for each of three scores: # events; mean duration; and % of time > 2.5 ft depth. (*NSM targets for Indicator Region 17 were adjusted using the average for indicator regions 14 and 18.)

☹**Performance:** Alternative 5 has too much high water. Indicator Region 14 has nine events averaging 14 weeks for 8% of total time. This is much worse than Alternative 4 (0% of time) and worse than the 2050 Base (5%) and Alternative 3 (5%). The NSM target is one event of three weeks duration (0%). Indicator Region 17 has 3% high water, which is similar to the 2050 Base, 1995 Base and Alternative 3, and not as good as Alternative 4 (1%). The adjusted target for Indicator Region 17 is < 1% of time. Indicator Region 18 has 2% high water; which is slightly higher than the 2050 Base and alternatives 3 and 4. The NSM target for Indicator Region 18 is zero. Overall, Alternative 5 does not meet NSM targets and does not perform as well as alternatives 3 and 4. During the 1994-1995 high rainfall period, Alternative 5 produces extreme depths in all three indicator regions, and is actually worse than the 1995 Base in Indicator Region 18.

Improvement Needed: Reduce high water events, possibility by adjusting L-67 weir design or operational rules. Bring 1994-1995 peak depths to NSM levels.

Performance Measure: Extreme Low Water (Indicator Region 14, 17 and 18).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth. (*NSM targets for Indicator Region 17 were adjusted using the average for indicator regions 14 and 18.)

☺**Evaluation:** Alternative 5 has less low water than NSM in all three regions and generally meets target criteria.

WCA-3B:

Performance Measure: Inundation Duration (Indicator Region 15).

Planning Targets: Match NSM #, mean duration and % of time.

☺ **Performance:** Hydroperiod in Alternative 5 is 99%, which exceeds the NSM target by 5%. This is similar to Alternative 3 (99% inundation). Overall, Alternative 4 and the 1995 Base are better matches for NSM hydroperiods.

Performance Measure: Extreme High Water (Indicator Region 15).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.

☺ **Performance:** Alternative 5 has 7% high water; this is improved over Alternative 4 (9%) but not as good as Alternative 3 (4%) or either of the bases. The 2050 and 1995 bases are closest to NSM target of 2%. Such high water would have negative ecological impacts, especially for tree islands.

Improvements needed: Reduce extreme high water.

Performance Measure: Extreme Low Water (Indicator Region 15).

Planning Target: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

☺ **Evaluation:** Alternative 5 has no low water events; this meets all targets.

PENNSUCO WETLANDS:

Performance Measure: Inundation Duration (Indicator Region 52 and 53).

Planning Targets: Match NSM #, mean duration and % of time.

Evaluation: Southern Pennsuco (Indicator Region 53) has an 87% hydroperiod; this does not match NSM (99%) but is improved over Alternative 4 (73%) and the 1995 and 2050 bases. Northern Pennsuco (Indicator Region 52) has a hydroperiod of 94%, which overshoots the NSM target of 89%.

Performance Measure: Extreme High Water (Indicator Region 52 and 53).

Planning Targets: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.0 ft depth.

Evaluation: NSM targets for Pennsuco need review, because NSM predicts only 5% depths greater than 2.0 ft in the north, but 29% depths greater than 2.0 ft in the south. Evaluation is postponed for now.

F. SOUTHERN EVERGLADES

Performance Measures: Ecological: Native and introduced aquatic organisms in canals.

Hydrological: Ponding depth differences SFWMM v. 3.4 relative to NSM v. 4.5; 1989 hydroperiod differences Alternative 3 SFWMM v. 3.4 relative to NSM v. 4.5.

Goal: Match NSM characteristics of the system.

Performance: Under Alternative 5, The Everglades Protection Area was less completely decompartmentalized than in Alternative 4 (e.g., L-28 was put back in). Canals and levees promote the extremes of ponding and overdrainage, with concomitant negative effects on freshwater aquatic communities. They increase the potential for dispersal of introduced plants and animals, and alter energy flow patterns in adjacent wetlands.

Improvement Needed: Remove the system of internal canals and levees or make them hydrologically invisible (the use of elevation control weirs should also be considered). Restore sheet flow to the historical central flow way of the southern Everglades and to short-hydroperiod marshes to the east and west of this central flow way. Eliminate canals as an artificial habitat and conduits for water routing and dispersal of plants and animals. Degrade levees that act as barriers to water flow and movement of aquatic animals and as conduits for exotic terrestrial biota.

Structural/Operational Changes: Restore sheetflow throughout the Everglades Protection Area.. Fill canals, degrade levees, place roads on causeways traversing interior marshes to allow unimpeded flow. Use the lowest management intensive strategies to establish rainfall-based flows.

Performance Measures: Ecological: Tree island hammocks; Peat-forming communities; Average water depth during peak alligator mating period in Shark Slough; Freshwater fishes and invertebrates; amphibians and reptiles; marl prairie.

Hydrological: Inundation duration summaries (Indicator Region 10, 11); Normalized weekly stage duration curves mid-Shark River Slough (Indicator Region 10) and for Northeast Shark River Slough (Indicator Region 11); Temporal variation in mean weekly stage for rockland marl marsh (Indicator Region 8); Normalized weekly stage duration curves for rockland marl marsh (Indicator Region 8).

Goal: Match NSM.

Performances: Shark Slough: Dry season flows and flows into the marsh were reduced and the number of dry-down episodes increased. In mid-Shark Slough, the marsh dried frequently during alligator nesting season.

Rocky Glades/Eastern Marl Prairies: Water levels remain significantly different from NSM.

Taylor Slough: Question the reliability of NSM in this area. Temporal patterns of stage and variability of stages differ from NSM predictions.

C-111: Dry-down frequency was greater than under NSM. Stages at some gauges remained both lower and higher than NSM predictions. What is the reliability of NSM in this basin?

Model Lands: Stages were lower than NSM and dry-downs more frequent.

Improvement Needed: Rainfall-based flows must extend from the upper to the lower reaches of the Everglades catchment area. Flows must be provided in sufficient volume to maintain dry season pool formations that persist within the downstream reaches of the system. Uninterrupted sheet flow through the entire system is needed and should be driven by adequate water storage in areas north of the Everglades Protection Area. Eliminate flood releases. Restore NSM hydropatterns.

Recommendation: Provide adequate water storage in areas north of the Everglades Protection Area to restore NSM hydropatterns. Explore using the lowest management intensive strategy to establish rainfall-based flows.

Structural/Operational Changes: Maintain stages adjacent to the Everglades Protection Area at levels that will prevent drainage of natural areas.

G. ESTUARIES AND BAYS

CALOOSAHATCHEE ESTUARY:

Performance Measure: The number of times salinity envelope criteria were not met for the Caloosahatchee Estuary.

Goal: A base flow of 300 cfs is needed to maintain appropriate salinity.

Performance: The number of minimum flow violations is well below the target value.

Performance Measure: The number of times high discharge criteria (mean monthly flow > 2,800 and 4,500 cfs) were exceeded for the Caloosahatchee Estuary.

Performance: The number of high flow violations is well below the target value.

Performance Measure: Regulatory releases from Lake Okeechobee.

Goal: None are desired.

Note: Alternative 5 had one regulatory release.

Recommendations: Overall, in Alternative 5 the Caloosahatchee has greatly exceeded the target values (good job!!!!).

ST. LUCIE ESTUARY:

Performance Measure: Minimum flow to the St. Lucie Estuary (350 cfs).

Goal: A base flow of 350 cfs is needed to maintain appropriate salinity.

Performance: Alternatives 4 and 5 were identical and have met the target for low flow.

Performance Measure: Number of times high discharge criteria (mean monthly flow > 1,600 & 2,500 cfs) were exceeded for the St. Lucie Estuary.

Goal: No regulatory releases, and reduction in high discharges for > 14 days.

Performance: Compared with Alternative 4, Alternative 5 increased the number of months of high flow discharge. A substantial amount of improvement is needed to attain the basin high flow targets.

Performance Measure: Regulatory releases from Lake Okeechobee.

Goal: None are desired.

Performance: Overall, the results in Alternative 5 were the same as Alternative 4. The low flow target has been reached. Two regulatory releases were added (previous alternatives have been at zero, the desired target).

Recommendations: Increase the C-44 stage from 14.5 ft to 15.5 ft. Continue moving toward meeting the target for high flows. Increased storage would be one method of meeting the target. Remove the two Lake Okeechobee regulatory releases.

LAKE WORTH LAGOON:

Performance Measure: Wet/Dry Season Average Flows Discharged to Lake Worth through S-40, S-41 & S-155 for the 31-year simulation.

Goal: To meet target flows to the Lake Worth Lagoon (0 - 500 cfs).

Performance: Alternative 5 displayed a small improvement over Alternative 4, but is still a long way from the target.

Recommendation: Add storage to the C-51 Basin. Continue moving toward increasing the number of low flow months and decreasing the number of high flow (>500cfs) months.

BISCAYNE BAY:

Performance Measure: Simulated mean annual surface flows discharged into Biscayne Bay for the 1965 - 1995 simulation period.

Goal: 1995 Base condition with 30% increase in dry season flows to the North and Central bay.

Performance: In Alternative 5, South Bay targets were exceeded and North Bay matched the 1995 Base. Alternative 5 displayed an increase over Alternative 4 in Central Bay and Snake Creek. Alternative 5 was the same as Alternative 4 in the Miami River.

Recommendations: Shift some of the water (amount above the target) from South Bay to Central Bay. Continue toward the Snake Creek target and the 1995 Base in the Miami River area.

FLORIDA BAY:

Performance Measure: P-33 stages above 6.3 ft msl.

Target: A reduced frequency of undesirable high salinity events in coastal basins of Florida Bay.

Performance: There are approximately 49 months of the 372-month period of record when NSM v.4.5 exceeds that stage, but Alternative 5 does not. Alternative 5 resulted in deficiencies in 6.3+ stages most frequently during January.

Performance Measure: P-33 stages above 7.3 ft msl.

Target: An increased frequency of desirable low salinity events in coastal basins of Florida Bay.

Performance: There are approximately 22 months of the 372-month period of record when NSM v.4.5 exceeds that stage, but Alternative 5 does not. Alternative 5 resulted in deficiencies in 7.3+ stages most frequently during July, September and October.

ROCKLAND MARL MARSH (INDICATOR REGION 8):

Performance Measure: Periods of uninterrupted flooding.

Goal: NSM; the Rockland Marl Marsh would have dried 29 times during the 31-year period of record, yielding uninterrupted periods of inundation that averaged approximately 8.5 months. Water depths averaged 0.5 ft during periods of flooding.

Performance: All alternatives to date were similar regarding the performance measure of duration of uninterrupted flooding, although Alternative 5 was slightly better than the others. All alternatives, including Alternative 5, were successful in maintaining a mean depth of approximately 0.5 feet during periods of flooding.

NORTHEAST SHARK RIVER SLOUGH (INDICATOR REGION 11):

Performance Measures: Duration of uninterrupted flooding, the maximum depth to which the water table drops during drought periods, and the water depth during periods of flooding.

Goals: NSM; dry-out once during the 31-year period of record, yielding uninterrupted periods of inundation that averaged more than 15 years. Water depth averaged two feet during periods of flooding, and the water table dropped to less than a foot below ground during the single drought period.

Performance: Alternative 5 was by far the best alternative to date regarding the performance measure of duration of uninterrupted flooding. Periods of flooding that averaged 7.5 years were interrupted by only three drydowns. Alternative 5 was also successful in limiting the depth to which the water table dropped during drought periods to the NSM level of approximately one foot. Alternative 5 was one-half foot deficient compared to NSM regarding mean water depth during periods of flooding.

MID SHARK RIVER SLOUGH (INDICATOR REGION 10):

Performance Measures: Duration of uninterrupted flooding, the maximum depth to which the water table drops during drought periods, and the water depth during periods of flooding.

Goals: NSM; dry-out three times during the 31-year period of record, yielding uninterrupted periods of inundation that averaged nearly eight years. Water depths averaged approximately 1.5 ft during periods of flooding, and the water table dropped to less than a foot below ground during the drought periods.

Performance: Periods of flooding that averaged ~3.3 years were interrupted by eight drydowns. Alternative 5 was the only alternative that was successful in limiting the depth to which the water table dropped during drought periods to the NSM level of approximately one foot. All alternatives, including Alternative 5, remained approximately one-half foot deficient in mean water depth during periods of flooding. This deficiency related to the P-33 Gage stage deficiencies that were indicated by the P-33 stage/coastal basin salinity relationships.

H. BIG CYPRESS SUBREGION

Performance Measure: Annual Average Hydroperiod Difference maps.

Goal: NSM match.

Performance: Much longer-than-NSM hydroperiods and higher peak stages in the vicinity and downstream of the S-190 pump station. It is desirable to reduce water levels in this area to enhance hydrologic restoration to the south and west.

Recommendations: Develop a mechanism for reducing hydroperiods and water levels in the vicinity and downstream of the new S-190 pump station by moving the water south and west into areas still showing drainage effects.

Performance Measure: Hydroperiod Maps.

Goal / target: Restore NSM conditions.

Performance: In the vicinity of the L-28 Tieback, there is still a small area of drained land in Alternative 5.

Recommendation: It appears that removal of or breaks in the L-28 Tieback could benefit this area.

I. WATER QUALITY

Performance Measure: Lower East Coast Service Area 2 Water Budget Report; Lake Okeechobee water deliveries.

Restoration Goal: An adequate supply of water to meet 2050 demands.

Performance: Alternative 5 created an increase over the 2050 Base condition in the volume of Lake Okeechobee water delivered to meet water supply demands.

Recommendations for Structural/Operational Changes: Implement wastewater reuse projects in Broward County; reduce/eliminate Lake Okeechobee deliveries to the Lower East Coast Service Area 2.

Performance Measure/Indicator: Mid-Perrine Marl Marsh hydroperiods.

Restoration Goal: (See Florida Bay Coastal Basins Report)

Performance: (See Florida Bay Coastal Basins Report).

Recommendations for Structural/Operational Changes: Model effect of proposed 100 MGD West Dade Wastewater Reuse facility with deliveries to C-111 Canal.

Performance Measure/Indicator: Loxahatchee National Wildlife Refuge (LNWR) Water Budget Report.

Restoration Goal: NSM-like/preferred hydropatterns & hydroperiods in LNWR.

Performance: Alternative 5 includes approximately 39,000 acre ft average annual volume discharged from the ACME basins to LNWR. Depths in southern LNWR exceed NSM.

Recommendations for Structural/Operational Changes: ACME water can be re-routed to the Everglades Agricultural Area for agricultural irrigation, Palm Beach County for water supply purposes, or WCA-2 to achieve NSM-like hydropatterns. ACME water can be stored in aquifer storage and recovery wells to achieve hydrologic (timing) objectives. Alternatively, model proposed ACME project in 2050 Base condition to clarify effect of ACME basin runoff pumped into LNWR.

Performance Measure/Indicator: Lake Okeechobee Water Budget Report.

Restoration Goal: Reduction of phosphorus loads to Lake Okeechobee consistent with Lake Okeechobee SWIM Plan.

Performance: Alternative 5 includes northern L-8 basin discharges to Lake Okeechobee totaling approximately 79,000 acre ft via the C-10A culvert and the yet-to-be constructed S-309 pump station. The L-8 Project which is part of the Everglades Construction Project does not include treatment for these flows discharged to the lake; however, the conceptual design for the ECP indicates that agricultural runoff contained in L-8 flows contains total phosphorus with an average concentration of approximately 226 ppb. Lake Okeechobee water discharges to the Everglades to meet hydrologic targets and to the lower east coast through the Everglades create performance problems for Everglades Construction Project and increase phosphorus loading in the Everglades.

Recommendations for Structural/Operational Changes: Construct a stormwater treatment area (STA) in the L-8 basin to treat agricultural runoff prior to discharge to Lake Okeechobee; alternatively, design a flow-way utilizing the Corbett/Dupuis Wildlife Management Areas to which northern L-8 flows could be directed prior to discharge to LNWR to meet rain-driven schedule volumes.

Performance Measure/Indicator: Lake Okeechobee Water Budget Report.

Restoration Goal: Flows discharged from the Everglades Construction Project to the Everglades Protection Area, including increased discharges resulting from the Restudy, must meet the yet-to-be-established numeric phosphorus criterion (default = 10 ppb).

Performance: Alternative 5 environmental water supply to Everglades is increased over the 2050 Base condition approximately 61,000 acre ft. These deliveries create an increased water

load to the ECP and increase the net phosphorus load to the ECP. This could lead to performance problems in the STAs unless it is assumed that Phase II supplemental technologies are capable of treating additional flows and loads to meet the ultimate numeric phosphorus criterion. Restudy flows and loads exceeding the 2050 Base condition must be treated to assure that the ECP continues to achieve the final numeric concentration criterion.

Recommendations for Structural/Operational Changes: None at this time.

Other Recommendations: Potential Phase II supplemental treatment technologies identified during the development of the ECP should be screened using the increased flows and loads associated with Restudy alternatives. Additionally, increased flows and loads associated with the 2050 Base condition should be evaluated (compared to ECP design flows and loads).

Performance Measure: Lake Okeechobee Water Quality Model (mean phosphorus in-loads and out-loads, wet year and dry year phosphorus in-loads and out-loads, median phosphorus concentrations, median chlorophyll a concentrations, median blue-green algae concentrations, difference from future base phosphorus concentration, difference from future base chlorophyll a concentrations, difference from future base blue-green algae concentrations).

Note: Not yet modeled. Lake Okeechobee Water Quality Model will be run soon with assumptions re: concentration/load reduction resulting from C-43 Reservoir/STA. The model is also being revised to better account for burial of phosphorous; should be completed by the end of April.

Performance Measures: Everglades Water Quality Model (mean phosphorus loads to the Everglades Protection Area, combined flow-weighted phosphorus concentrations for S-12s/S-33, mean grid cell phosphorus concentrations and differences, LNR 14-station mean phosphorus concentration, basin phosphorus concentrations).

Note: Not yet modeled. Everglades Water Quality Model runs are being revised to account for actual structural concentrations in the 1995 Base, partitioned water flows (bypasses = historic concentrations in 1995 Base, 0.75 historic concentrations in 2050 Base and for alternatives, Lake Okeechobee water = historic concentrations for lower east coast water supply in 1995 Base, 40 ppb in 2050 Base).

Notes: Need to determine how the Restudy will affect the Everglades Construction Project, including Phase II treatment targets. Need to deal with 2050 Base flows/loads and Restudy flows/loads (section of Programmatic Environmental Impact Statement). Restudy flows/loads greater than design flows/loads. If Lake Okeechobee is the source of increased flows/loads, need to quantify how much recovery/restoration of the lake is expected in the 2050 Base (Surface Water Improvement Management Plan still in effect); then, quantify effect of increased flows and loads from the lake to the Everglades Construction Project.

J. ATLSS / THREATENED AND ENDANGERED / KEYSTONE SPECIES

An individual-based ATLSS simulation and Population Viability Analysis are available for the western sub-population of the Cape Sable seaside sparrow. Breeding Potential Indices (BPIs) are addressed for other Cape Sable seaside sparrow sub-populations and white-tailed deer. For wading birds, ATLSS produces a Foraging Conditions Index with separate analyses for

short-legged and long-legged species. Outputs on total fish abundance and fish prey base for wading birds are also available. Differences in inputs and methods make comparisons of Alternative 5 results to other alternatives difficult in some cases. Performance indicators for Cape Sable seaside sparrows and American crocodiles are also addressed.

FISH:

Performance Indicator: ATLSS fish model.

Goal: None set.

Performance: The ATLSS fish model predicts that Alternative 5 hydrologic conditions will produce average fish abundances consistently higher than those expected for 2050 Base, particularly in NE Shark River Slough, WCA-3B, WCA-3A south, WCA-1 and WCA-2A. This is also true when only prey-sized fish at appropriate wading bird foraging depths are counted. Exceptions occur in WCA-2B, northeastern WCA-3A, East Slough and South Big Cypress, where Alternative 5 produces slightly lower fish densities than the 2050 Base. Alternative 5 results are very similar to alternatives 2-4, with very slightly higher average densities for Alternative 5.

WADING BIRDS:

Performance Indicator: ATLSS wading bird Foraging Conditions Index.

Performance: 1. Eastern rookeries (eastern WCA-3A, WCA-3B and NE Shark River Slough): On average, Alternative 5 predicts slightly lower foraging condition values than 2050 Base for short-legged wading birds and mixed results (leaning toward lower values for Alternative 5) for long-legged wading birds. 2. Historic Shark Slough/mangrove estuary interface rookeries: For short-legged wading birds, Alternative 5 predicts higher foraging condition values than 2050 Base in south Taylor Slough, East Slough and scattered sites in Big Cypress and lower values than 2050 Base for the main Shark Slough drainage where a majority of the traditional rookeries area located. For long-legged wading birds, Alternative 5 produced equal or marginally higher values than 2050 Base. Changes in input data make comparison of Alternative 5 results to other alternatives difficult.

Recommendation: Bring down overly deep water levels in eastern WCA-3A and WCA-3B and reduce dry season reversals.

WHITE-TAILED DEER:

Performance Indicator: ATLSS white-tailed deer Breeding Potential Index.

Performance: Alternative 5 would slightly improve the generally poor breeding conditions for white-tailed deer in SE Big Cypress, northwest ENP, southeast ENP, Holey Land, Rotenberger and WCA-2B as compared to the 2050 Base, particularly in years with average to above average rainfall. Alternative 5 would slightly decrease the very low breeding potential in NE Shark Slough and WCA-3B as compared to 2050 Base. For those few areas with high deer breeding potential (Long Pine Key and surrounding short hydroperiod marsh and NW Big Cypress), there is little difference between Alternative 5 and the 2050 Base. These results are similar to Alternative 4 except for increased breeding potential in WCA-3B under Alternative 5.

Recommendation: No recommendations are provided for desired improvements or structural/operational changes because no performance target has been set.

CAPE SABLE SEASIDE SPARROW:

Performance Indicator: Indicator Region 46 - Cape Sable seaside sparrow west.

Performance: On average, during the sparrow breeding season, Alternative 5 produces longer hydroperiods than Alternative 4 and slightly longer hydroperiods than Alternative 3. The 1995 Base and Alternative 4 produce dry conditions at about three weeks earlier than Alternative 5 and Alternative 5 re-floods the area a few days earlier than Alternative 4.

Performance Indicator: ATLSS Cape Sable seaside sparrow Breeding Potential Index.

Performance: Alternative 5 produced lower breeding potential in all areas as compared to Alternative 4. Alternative 5 produced slightly improved breeding potential in the western sub-population area, and lower breeding potential in the core and eastern sub-population areas as compared to the 2050 Base.

Recommendations: Bring hydrological conditions in the western sub-population area back to Alternative 4 conditions and bring hydrological conditions in the core and eastern sub-populations areas back to Alternative 3 conditions.

Performance Indicator: ATLSS Cape Sable seaside sparrow Individual-based Simulation.

Performance: The ATLSS individual-based sparrow simulation is applied only to the western sub-population, and predicts persistence of this sub-population under alternatives 3, 4 and 5. Alternative 5 produced lower population levels and a greater risk of extirpation than alternatives 3 and 4. A Population Viability Analysis using the individual model predicts that the western sub-population will be less likely to remain above minimum numbers and reach or exceed maximum numbers under Alternative 5 than under alternatives 3 and 4. Under the 2050 Base, this model predicts a much higher probability of extirpation.

Recommendations: Bring hydrology in the western sub-population area back to Alternative 4 conditions.

AMERICAN CROCODILE:

Performance Measure: Crocodile habitat suitability.

Performance: Performance measure outputs are now available. Alternative 5 is the best yet for crocodiles, with reductions in time habitat experiences salinities >40 ppt and some improvements in time spent at lower salinities. These results are better than those for the 2050 Base and 1995 Base, but do not yet reach the lower salinities predicted by NSM.

Recommendations: Increased flows to Florida Bay, particularly in dry years.

SNAIL KITE:

ATLSS outputs are not available for Alternative 5. The subteam has been assured that they will be available for Alternative 6.

AET Subteam Narratives

A. Total System Subteam

See the subteam's highlights report.

B. Kissimmee / Lake Okeechobee Subteam

Performance-Based Comments:

Water inputs to the lake were 130,300 acre ft (3%) greater in Alternative 5 than Alternative 4, and 235,800 acre ft (6%) greater in Alternative 5 than the 2050 Base condition. The major new input of water in Alternative 5 (152,000 acre ft) was from the C-43 reservoir. Water outputs from the lake were 125,900 acre ft (3%) greater in Alternative 5 than Alternative 4, and 224,400 acre ft (6%) greater in Alternative 5 than the 2050 Base condition. The greatest increases in water output under Alternative 5 were to EAA storage and the WCAs. In contrast, the water deliveries from Lake Okeechobee to the Everglades were reduced by 224,000 acre ft in Alternative 5 as compared to the previous alternative.

The stage duration curve for Alternative 5 has a similar “shape” to that displayed by Alternative 4; however, it is notably increased in height at all but the lowest lake levels.

Box-and-whisker plots showing the “similarity in lake stages” indicate that 25th and 75th percentiles for water levels under Alternative 5 were within a desirable (from the standpoint of ecosystem health) 12 to 15 ft NGVD depth. Extreme lows and highs do occur in Alternative 5, but at a relatively low frequency.

The daily stage hydrographs indicate the following return frequencies (number of events in 31 years) for extreme high (>17 ft NGVD) and low (<11 ft NGVD) lake stages:

Category	Goal	95 Base	50 Base	Alt 2	Alt 3	Alt 4	Alt 5
> 17 ft	few events	6	5	4	3	2	3
< 11 ft	few events	8	12	9	6	8	3

Alternative 5 supports the goal of protecting the lake ecosystem from extreme high and low water events.

Box-and-whisker plots showing the similarity in duration of stage events >15 ft NGVD indicate that under Alternative 5, both the median and 75th percentile durations for such events were less than six months. This is a positive result. Prolonged periods of moderately high lake levels (which are rare under this alternative) harm the ecosystem due to losses of benthic plant communities, and greater lake-wide circulation of turbid, phosphorus-rich water. Increases in lake-wide phosphorus concentrations could impact downstream ecosystems that receive water from the lake.

Box-and-whisker plots showing the similarity in duration of stage events <12 ft NGVD indicate that under Alternative 5, both the median and 75th percentile durations for such events were less than six months. This is another positive result. Prolonged periods of moderately low

lake levels harm the ecosystem due to losses of wildlife habitat and increased rates of exotic plant expansion.

Box-and-whisker plots showing the similarity in duration of stage events <11 ft NGVD indicate that under Alternative 5 there was a very short (approximately 25 days) median duration for such events, and just one extreme value of >400 days. In general this also is a positive result.

None of the scenarios evaluated to date, including Alternative 5, had significant effects on the frequency of occurrence for spring lake level recessions. In all cases, January to May recessions from 15 to 12 ft NGVD (without major reversals) occurred in approximately 20 to 25% of years. In light of the other positive results, and continued uncertainties regarding linkages between recession characteristics and ecological values, there are no strong recommendations to address the issue at this time.

Comments Received By Email from Outside Reviewers:

National Audubon Society:

The National Audubon Society appreciates the opportunity to comment on Alternative 5 in the Central & Southern Florida Comprehensive Restudy Process. Dr. Mark Kraus, Dr. Wayne Hoffman, Jerry Lorenz, Karsten Rist and Tom Corcoran prepared the following analysis.

ALT5 (16% of time exceeded) still shows improvement compared to ALT3 (24% of time exceeded) but declines compared to ALT4 (10% time exceeded) on the stage duration curves in respect to lake stages exceeding 15 feet NGVD (represents the lake elevation above which entire littoral zone is flooded).

ALT5 (14% of time exceeded) is an improvement over ALT4 (22% of time exceeded) on the stage duration curves in respect to the lake stages falling below 12 feet NGVD (below 12 feet NGVD represents more than 90% of the entire littoral zone is dry).

Looking at the number of undesirable Lake Okeechobee stage events it appears ALT5 has increased in the number of times stages are greater than 17 feet for greater than 50 days by about 33% to the historical level and compared to ALT4. The number of times stage is less than 12 feet for greater than one year has been cut in half in ALT5 compared to ALT4. The number of times stage is less than 11 feet for greater than 100 days has decreased in ALT5 compared to ALT4 and about the same as historical stages. And, the number of times stage events are greater than 15 feet for greater than 2 years is still eliminated in ALT5.

Carl Woehlcke (SFWMD):

Water quality issues regarding large untreated inflows from the L-8 and the St. Lucie Canal Basins into Lake Okeechobee remain unaddressed. Perhaps a reservoir/STA located between the two discharges to the Lake could serve to treat water from both basins. The STA could also be used to treat Lake Okeechobee water when there is no backflow from either of the basins. This would help with another problem. There are still too many periods of high flow to the St. Lucie Estuary. The St. Lucie canal does not contribute to this problem when the Lake is below 14.5 because its runoff flows back into the Lake. Having this water come back to the Lake when the

Lake is at higher stages should reduce the periods of excessive flows. Having a water quality treatment facility would make it more feasible to gain approval of putting more water from the St. Lucie Canal basin back into the Lake.

Performance Measures and Indicators Used:

Measures: box-whisker plots showing similarity in lake stages
 box-whisker plots showing duration of >15 ft lake stage events
 box-whisker plots showing duration of <12 ft lake stage events
 box-whisker plots showing duration of <11 ft lake stage events
 daily hydrographs with spring recession windows

Indicators: lake inflow, outflow, and ET volumes
 30 year daily hydrographs
 stage-duration curves

Recommendations:

Performance measure: Number of stage events >17 ft.

Indicator used: Daily stage hydrographs for Lake Okeechobee.

Comments: Under Alternative 5 there were three such events. This is comparable to the results for Alternative 4 (two events) and Alternative 3 (three events), and is an improvement over both the 2050 Base (five events) and the 1995 Base (six events).

Recommendation: Maintain this low frequency.

Performance measure: Number of stage events >15 ft lasting > 6 months.

Indicator and measure used: Daily stage hydrographs and similarity in duration of stage events >15 ft.

Comments: Under Alternative 5 there were three such events. This is comparable to the results for Alternative 4 (two events) and Alternative 3 (three events), and is an improvement over both the 2050 Base (six events) and the 1995 Base (seven events). The median duration of >15 ft events remains low (~30 days) under Alternative 5. This also is a positive result.

Recommendation: Maintain the low frequency and duration of >15 ft events.

Performance measure: Number of stage events <12 ft lasting >6 months.

Indicator and measure used: Daily stage hydrographs and similarity in duration of stage events <12 ft.

Comments: Under Alternative 5 there were three such events. This is an improvement over all previous alternatives, and matches the frequency under the 1995 Base. The median duration of <12 ft events is very low (~30 days) under Alternative 5. This also is a positive result.

Recommendation: Maintain the low frequency and duration of <12 ft events.

Performance measure: Number of stage events <11 ft.

Indicator used: Daily stage hydrographs for Lake Okeechobee.

Comments: Under Alternative 5 there were three such events. This is a dramatic improvement over Alternative 4 (eight events), Alternative 2 (nine events), the 2050 Base (12 events) and the 1995 Base (eight events). The median duration of <11 ft events also is low (~25 days) under this alternative.

Recommendation: Maintain the low frequency and duration of <11 ft events.

Conclusions Regarding Alternative 5:

Alternative 5 represents the best, and most balanced, alternative considered to date from the standpoint of preventing harmful high and low water levels in Lake Okeechobee.

Conclusions Regarding Alternative 5 with Decompartmentalization:

A scenario of WCA decompartmentalization was run along with Alternative 5. This scenario causes serious harm to the lake, resulting in dramatic decreases in median and minimum water levels. The percent of time when the lake is below 12 ft (when more than 90% of the littoral zone is dry) increases from 14% in Alternative 5 to 42% in this scenario. Lake levels fall below 11 ft (when nearly the entire littoral zone is dry) a total of 18 times in this scenario, and on one occasion, the lake drops below 8.0 ft for nearly a year. At 8.0 ft, the extent of surface water would match closely with the extent of soft mud sediments on the lake bottom. The small, shallow lake would likely contain highly turbid, nutrient-rich water. Serious ecological damage (perhaps massive fish kills) might be expected to occur under these conditions, even if they lasted only a short period of time.

C. Lake Okeechobee Service Area Subteam

Performance Based Comments:

The performance in meeting demands in the Lake Okeechobee Service Area was much improved in Alternative 5. The target established by the AET, based on the state goal of a 1-in-10 level of service, is that there be no more than three events (water years) during the 31-year simulation in which the Lake Okeechobee Service Area is under supply-side management (not all demands are met). While there were six such events in Alternative 5, in three of the years the restrictions were in effect for only one or two months and involved small supply-side management cutback volumes. In water year 1974 there was one month of restrictions involving 3,000 acre feet. Comparable figures for the other two water years with minor restrictions are, for 1978, 2 contiguous months and 28,000 acre feet and for 1991, two non-contiguous months and 25,000 acre feet. In contrast the three remaining years with water restrictions (1981, 1982 and 1989) involved large supply-side management cutback volumes of over 200,000 to over 500,000 acre feet. The 1981 to 1982 period, which encompasses 16 continuous months of shortages with over 775,000 acre feet of supply-side management cutback volumes, is of particular concern. Nine of these months are in the 1981 water year. This exceeds the AET performance goal that no event exceed seven months in duration.

The general evaluation of the LOSA subteam is that performance in Alternative 5 is close to meeting the performance targets regarding water supply for LOSA. The major concern is with the severity of the restrictions in the 1981/1982 period.

The water shortage frequency of six events in Alternative 5 is much better than the frequency modeled in the 1995 Base, in which there were 10 years with water restrictions. Alternative 5 conditions are also much better than those of the 2050 Base, and all of the previous alternatives. The best of these was Alternative 3, which had eight events. In comparison the

2050 Base had 15 years with restrictions; Alternative 1, 11 years; Alternative 2, 12 years; and Alternative 4, 11 years.

In Alternative 5 the percentage of demands not met was 6% in the EAA and 9% for the rest of the Lake Okeechobee Service Area. In contrast, for Alternative 4 and Alternative 3, the percentage of demands not met was 10% in the EAA and 12% for the rest of the Lake Okeechobee Service Area. The percentages of demands not met for Alternative 5 are also less than the percentages of demands not met for the 1995 Base (11% and 15% respectively), for the 2050 Base (22% and 23% respectively) and for Alternative 2 (15% and 15% respectively).

In Alternative 5 the percentage of demands not met during five selected drought years (1971, 1975, 1981, 1985 and 1989) was a much higher 16% for the EAA and 16% for the rest of LOSA. These demands not met were higher than the 13% (EAA) and 11% (rest of LOSA) achieved in Alternative 3, which had the best performance during drought years of any of the alternatives.

Maintaining existing levels of flood protection is also a goal in the Lake Okeechobee Service Area. Available performance measures that indicate whether flood protection is being maintained include peak stage difference maps and statistics on backpumping from the EAA to Lake Okeechobee contained in the EAA water budget. These measures only apply to the EAA. Both these sources indicate that flood protection in Alternative 5 has not deteriorated when compared to the 1995 Base. Higher peak stages are not observed in the EAA outside of reservoirs, STAs and environmentally managed areas. In addition backpumping to Lake Okeechobee, which occurs only when flood waters reach threatening levels, is much less in Alternative 5 than it was in the 1995 Base. A more discerning flood control performance measure, specifying the number of days in which water to be removed exceeded removal capacity in the EAA, is still being developed and was not available for posting on the web site. However, preliminary data available for Alternative 5 indicate that the number of such days in Alternative 5 was relatively small and distributed across the years of the simulation.

Performance Measures and Indicators Used:

1. Frequency of Water Restrictions
2. Lake Okeechobee Daily Stage Hydrograph
3. Mean Annual EAA/LOSA Irrigation Demands and Demands not Met
4. Report – Monthly and Annual Supply-Side Management Results
5. Report – Cumulative Total Demand, Cutback Volume, and Cutback over Period of Simulation
6. Water Shortages by Phase and Trigger output
7. EAA and LOSA Demands – Dry Years
8. Total Irrigation Supply and Shortages for Seminole Tribe, Big Cypress Reservation
9. Lake Okeechobee Service Area Subregion Reports on Annual Demands & Demands not Met
10. C-43 & C-44 Basin Regional Irrigation Supply and Demand not Met
11. Other LOSA Supplemental Irrigation Supply and Demand not Met
12. Number of Undesirable Lake Okeechobee Stage Events
13. Peak Stage Differences (.25 ft. higher)
14. Average Inflows and Outflows to Lake Okeechobee

Public Comments Received (paraphrased):

1. Gail Murray for the Seminole Tribe: Improvements to demands not met for the Big Cypress and Brighton Reservations in Alternative 5 were noted. Concern was expressed over the results of the DCMP1 run which consisted of Alternative 5 with additional decompartmentalization features and showed much poorer performance in meeting LOSA demands.
2. Steve Lamb for the Agricultural Coalition: No comment on water supply performance. Comments limited to proposed alternative reservoir operating assumptions that could reduce the use of ASR systems and result in more backpumping.

D. Lower East Coast Subteam

Summary: Alternative 5 generally improves the ability of the regional system to meet water supply demands for the Lower East Coast when compared to Alternative 4. Alternative 5 meets the 1-in-10 year water demand performance measure for Service Area 1, just misses the performance measure for Service Areas 3 and North Palm Beach County, and fails to meet it in Service Area 2. The majority of the locally triggered water supply cutbacks in the service areas are due to just a few low areas in Southeastern Broward County; i.e. low groundwater levels are not affecting the entire service area. The inability to maintain ground water levels in the C-10 and C-12 appear to be systematic and not a result of public water supply pumping. The instability of ground water levels and the potential movement of the salt front needs to be addressed as a regional problem, not a localized wellfield problem. The conservation component helped to achieve reductions in locally triggered cutbacks at a handful of trigger wells, Pompano, Lake Worth, North Lauderdale, and Clear Lake. The significant reductions in local triggered cutbacks are due to the addition of components and changes in operations designed specifically for Hollywood and Homestead. The water supply cutbacks due to low levels in Lake Okeechobee have dropped considerably. The higher levels in Lake Okeechobee and the reduction in deliveries to the LEC from Lake Okeechobee are due to increases in local storage and supplies (reuse). However, another issue persists regarding the methods used to achieve these improvements to water supplies. The saltwater intrusion criteria for coastal canals are met for LECSA. This is a substantial improvement when compared to previous alternatives. Significant progress was made in Alternative 4 for flood protection, some of which was lost in Alternative 5 leaving a mixture of impacts on flood protection for agriculture in South Dade.

WATER SUPPLY

Performance Based Comments: Locally triggered water supply cutback events were reduced to only one month in the North Palm Beach Service Area. The frequency of Lake Okeechobee triggered cutbacks was reduced to three for the service area.

Performance Measures and Indicators Used: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for North Palm Beach Service Area. Frequency of Water Restrictions for the 1965-1995 Simulation Period – North Palm Beach County.

Recommendation: Maintain the good performance.

Performance Based Comments: Locally triggered water supply cutback events were reduced to zero in Service Area 1. The frequency of Lake Okeechobee triggered cutbacks was reduced to three for the service area.

Performance Measures and Indicators Used: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for Service Area 1. Frequency of Water Restrictions for the 1965-1995 Simulation Period – Service Area 1.

Recommendation: Maintain the good performance.

Performance Based Comments: The frequency of Lake Okeechobee triggered cutbacks were reduced to three for the service areas. Twelve shortage events for the period of record are caused by local trigger wells. The low ground water levels near the Hollywood and Ft Lauderdale Airport triggers are causing the water supply cutbacks. Moving Hollywood's demands west has helped some, but has not solved the problem of low ground water levels in the C-10 basin. The number of months of low ground water levels near the Hollywood trigger has been reduced from 22 months in Alternative 4 to seven in Alternative 5. The number of months of low ground water levels near the Ft Lauderdale Airport trigger remains high at 24. Other factors besides the amount of water pumped at nearby wellfields are affecting the ground water levels in the basin and triggering the restrictions.

Performance Measures and Indicators Used: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for Service Area 2. Frequency of Water Restrictions for the 1965-1995 Simulation Period – Service Area 2.

Recommendation: Additional water could be routed from the C-9 Basin to the C-10 Basin and from the C-12 to secondary canals to recharge the aquifer.

Performance Based Comments: Two water supply cutback events for the period of record are caused by local ground water conditions. Alternative 5 components have reduced the water supply cutbacks due to low ground water levels in Homestead to zero. Low ground water levels can only be found near the Taylor Slough trigger. In addition, there were only three Phase 1 water supply cutback events due low water levels in Lake Okeechobee.

Performance Measures and Indicators Used: Frequency and Severity of Water Restriction Triggers for the 1965-1995 Simulation Period for Service Area 3.

Frequency of Water Restrictions for the 1965-1995 Simulation Period – Service Area 3.

Recommendation: Review use of the Taylor Slough trigger since public water supply pumping does not effect it. It may need to be moved or modified to accurately reflect the potential for the salt front to move inland.

CANAL LEVELS

Performance Based Comments: All canal levels meet or exceed the saltwater intrusion criteria for the North Palm Beach Service Area.

Performance Measures and Indicators Used: % of time Canal Stage less than Saltwater intrusion Criteria and Occurrences greater than one Week for North Palm Beach Service Area, stage hydrographs and stage duration curves.

Recommendations: Maintain the good performance.

Performance Based Comments: All canal levels meet or exceed the saltwater intrusion criteria for Service Area 1.

Performance Measures and Indicators Used: % of time Canal Stage less than Saltwater intrusion Criteria and Occurrences greater than one Week for Service Area 1, stage hydrographs and stage duration curves.

Recommendations: Maintain the good performance.

Performance Based Comments: All canal levels meet or exceed the saltwater intrusion criteria for Service Area 2.

Performance Measures and Indicators Used: % of time Canal Stage less than Saltwater intrusion Criteria and Occurrences greater than one Week for Service Area 2, stage hydrographs and stage duration curves.

Recommendation: Continue current operation of C-9 to maintain or increase surface and ground water levels.

Performance Based Comments: Flows over S-13 and S-13A are reduced by half and to zero, respectively, diminishing the amount of water able to be supplied to the Pond Apple Slough. The Slough is located just east of the Ft Lauderdale Airport. Rehydration of the Slough, a joint project by the SFWMD and Broward County – DNRP, requires additional waters to be sent east on the C-11 over the S-13.

Performance indicator: Mean wet/dry Season Flows to Pond Apple Slough through C-11@S-13 for the 31-year simulation, stage hydrographs and stage duration curves for S-13 and S-13A.

Recommendation: Modify operation of C-11 and C-9 Reservoirs to provide more flows east. Perhaps component Q4 could be modified so that when storage is not available in the Central Lake Belt Storage Area flows are sent east to Pond Apple Slough (S-13) or water may be able to be routed from the North New River Canal south through the Flamingo Canal to the C-11.

Performance Based Comments: Flows over S-33 remain constant for all alternatives, but increase in Alternative 5. It has been documented by BC-DNRP that additional flows are necessary to prevent tidal saltwater intrusion of the North Fork. Restoration of the North Fork of the New River is a Critical Project of the Corps and is sponsored by Broward County.

Performance indicator: Mean wet/dry Season Flows to North Fork of New River C-12@S-33 for the 31-year simulation, stage hydrographs and stage duration curves.

Recommendation: Continue the increase in flows on the C-12 east. This may also increase ground water levels near the Ft Lauderdale Airport trigger.

Performance Based Comments: Alternative 5 continues the significant decrease in the number of times the canals were not able to meet the saltwater intrusion criteria that was achieved in Alternative 4 for the C-6, C-4 and C-2. This is a great improvement over Alternative 3 when the C-4 and C-2 failed to meet the criteria 27% and 21% of the time.

Performance Measures and Indicators Used: % of Time Canal Stage < Saltwater Intrusion Criteria and Occurrences >1 Week - Canal C-6 at S-26, C-4 @S-25B, and [C-2@S-22](#), stage duration and stage hydrographs.

Recommendation: Maintain the good performance

Performance Based Comments: Many of the South Miami-Dade County canal water levels have shown some improvement in alternatives 4 and 5. C-1, C-100B, C-102N, and C-103S have shown some improvement with respect to the 1995 and 2050 bases.

Performance indicator: Stage duration curves for C-100A, C-100B, C-102N, C-103, C-111, C-103S, C-102, and C-1, stage duration and stage hydrographs.

Recommendation: Maintain the good performance in Alternative 6.

RESERVOIRS

Performance Based Comments: More water is available from the Site 1 reservoir in Alternative 5 than in Alternative 4. The reservoir is dry only 30% of the time and the duration curve is much higher in Alternative 5 than in Alternative 4.

Performance indicator: Stage duration curves for Site 1 Reservoir.

Recommendation: Maximize use of reservoir.

Performance Based Comments: The reservoir is a little wetter when compared to Alternative 4.

Performance indicator: Stage duration curves for C-9 Reservoir.

Recommendation: Keep enough water in the C-9 Reservoir to maintain ecological values while maintaining the C-9 above the saltwater intrusion criterion at the eastern structure.

Performance Based Comments: Operation of the Bird Drive impoundment needs to be reexamined and/or more water needs to be routed from the regional system to hold consistently higher levels in these canals. The stage duration curve exceeds ground elevation only 3% of the time, which is less often than Alternative 3. Water quality concerns have been addressed by directly flows from urban areas away from the reservoir.

Performance indicator: Stage duration and hydrographs for Bird Drive Reservoir.

Recommendation: May need to look at the need of this component.

Performance Based Comments: The Central Lakebelt Storage described in Alternative 5 seems to perform well. The reservoir is filled 50% of the time.

Performance indicator: Stage duration and hydrographs for Central Lakebelt Reservoir.

Recommendation: Some water could be to used to maintain stages in the Dade-Broward Levee Canal, enhance supplies to the South Dade Conveyance System or improve dry season flows to Biscayne Bay.

Performance Based Comments: The North Lakebelt Storage described in Alternative 5 seems to perform well.

Performance indicator: Stage duration, hydrographs and water budget for the North Lakebelt Reservoir.

Recommendation: Maintain performance, especially providing flows to C-9.

DISCHARGES TO TIDE

Performance Based Comments: For Alternative 5, there were continued decreases in the discharges to tide, yet the saltwater intrusion criteria is still able to be met the vast majority of the time. The mean annual reduction in discharges to is approximately 1,008,000 acre ft.

Performance indicator used: Mean Annual Surface Flows Discharged to Tide from the LECSA for the simulation period.

WATER DELIVERIES

Performance Based Comments: The volume of water supplied on average has increased when compared to the 1995 Base, 2050 Base and Alternative 3 for Service Area 1 by up to 60%, increased for Service Area 2 by 200%, and increased for Service Area 3 by approximately 30%. Much of the increase in deliveries is due to increased reliance on ASR and reservoirs to supply water. During drought events, deliveries from Lake Okeechobee and WCAs have declined for Alternative 5 when compared to Alternative 4. Deliveries for drought events actually increase in Alternative 5 when compared to the 1995 and 2050 bases for Service Areas 1 and 2. During wet years, the Lower East Coast Service Areas have gained some self-sufficiency, but they are still dependent on the regional system and new sources of water during drought events. Maintaining storage areas in the regional system is the key to overcoming droughts in the LECSA.

Performance indicator used: Number of days and volume LECSA Water Supply Deliveries were made from Lake Okeechobee for simulation period.

FLOOD PROTECTION

Performance Based Comments: Significant progress was made in Alternative 4 towards increased flood protection, some of which was lost in Alternative 5. Four cells are at an increased risk to flooding. For R17C27, R12C28, R10C25, and R20C27 the stage duration curve for Alternative 5 meets the 83-93 target. There are no threats of flooding apparent. For R15C26 the stage duration curve is about a half a foot above the 1983-1993 target line and is also above the 1995 Base. However, for this cell the water levels are within the 2-foot root zone only 15% of the time. For R13C25 the stage duration curve is comparable to Alternative 4, but still a half a foot above the 1983-1993 target and the 1995 Base. The water levels are within the two foot root zone 44% of the time, which unacceptable. For R19C27 the stage duration curve for Alternative 5 is higher than Alternative 4 and just 4-5 inches above the 1983-1993 target. The two-foot root zone is saturation 73% of the time, which is also unacceptable.

Performance indicator: Stage Hydrographs and duration curves for R10C25, R17C27, R12C28, R20C27, R13C25, R19C27 and R15C26.

Recommendation: Increase flood protection in R15C26, R13C25, R19C27.

E. Northern / Central Everglades Subteam

Loxahatchee National Wildlife Refuge (WCA-1)

Performance Based Comments:

Overall, Alternative 5 hydroperiods in WCA-1 match the 1995 Base case, which meets the USFWS regulation schedule. Only 80.7% of the area matched NSM hydroperiods which is similar to the 1995 Base (80.7%), greater than the 2050 Base (77.2%), but less NSM-like than either Alternative 3 (94.7%) or Alternative 4 (84.2%). Alternative 5 hydroperiods exceed NSM in the south (Indicator Region 26), but are similar to NSM in the north (Indicator Region 27). The best overall NSM “alternative” match is still Alternative 3. While high water criterion is exceeded only once in northern LNWR, it is exceeded 28 times for an average duration of 14 weeks in southern LNWR. Depths exceed 3.0 feet approximately 8% of the time, which is slightly less than the 1995 Base, slightly more than the 2050 Base and much more than Alternative 3. There are no extreme low water depth criterion exceedences.

Performance Measures and Indicators Used:

1. Hydroperiod difference map
2. Indicator Region statistics for Regions 26 and 27 (inundation duration summary table, high water/low water summary table, stage duration curves, temporal variation in weekly stages)

Recommendations:

If NSM-like conditions are desired, decrease ponding in southern WCA-1 to better match NSM conditions.

Subteam Issues:

If NSM conditions are desired, we should continue to utilize the rainfall-driven water deliveries to the refuge as part of the regional restoration strategy for the Everglades. LNRW staff supports the suggestion to review high water exceedence criterion.

WCA-2A

Performance Based Comments:

Alternative 5 hydroperiods are similar to Alternative 4 for northern (Indicator Region 25) and southern (Indicator Region 24) WCA-2A. While the south has NSM-like conditions, the north stays inundated for 98% of the year with only eight events averaging 198 weeks compared to NSM with 22 events averaging 67 weeks for an average annual hydroperiod of 92%. Temporal variation of mean weekly stages in Alternative 5 is similar to Alternative 4. Wet season depths in northern WCA-2A (Indicator Region 25) peak earlier than NSM and dry season depths exceed NSM by about 0.3 – 0.5 ft, whereas Alternative 3 and the bases are similar to NSM.

Alternative 5 has more high water events in both northern and southern areas than NSM (four events in the north, average four weeks duration; nine events in the south, average five weeks duration). These frequencies exceed NSM targets of zero. This is worse than 1995 and 2050 bases and Alternative 3 but slightly better than Alternative 4. Northern WCA-2A has only one low water event. Southern WCA-2A is similar to NSM. Alternative 5 had more events than Alternative 4 but it is improved over both base cases

Performance Measures Used:

Indicator Regions 24 and 25

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands, NSM flood levels). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth
3. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

4. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 24 and 25
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 24 and 25
3. Inundation Pattern (1965-1995) for Indicator Regions 24 and 25
4. Stage Duration Curves for Indicator Regions 24 and 25
5. Stage Duration Curve at Gage 2-17

Recommendations:

The main objective is to further adjust dry season depths upward in WCA-2B and downward in WCA-2A, with changes in the average annual minimum on the order of 0.2-0.3 ft relative to Alternative 5.

WCA-2B

Performance based comments:

Alternative 5 hydroperiods in WCA-2B are 80% compared to 95% for NSM. This is not as NSM-like as the 2050 or 1995 bases but is improved over Alternative 4 (70%). Hydroperiod and extreme low measures for WCA-2B in Alternative 5 are similar, but not quite as severe, as the statistics for NW WCA-3A in the 1995 Base; this suggests that the predicted condition for WCA-2B under Alternative 5 would be similar to present-day northern WCA-3A, i.e., too dry. WCA-2B's annual average minimum is approximately 0.3 ft below ground, vs. NSM's which is about 0.5 ft above ground (source: "temporal variation in stage, Indicator Region 23). Depths in WCA-2B are more than 1.0 ft below ground 7% of time. This is slightly worse than the 2050 and 1995 bases but better than Alternative 4 (11%). The NSM target is 1%. With respect to high water exceedence, Alternative 5 has the best performance so far with only 3% of time above 2.5 feet. The NSM target is 0%. This is much better than the 1995 and 2050 bases and slightly better than Alternative 4 (4%).

Performance Measures Used:

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands, NSM flood levels). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth.
3. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.
4. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.

Recommendations:

Decrease extreme low water events if possible. It is doubtful that NSM depths could be achieved in WCA-2B, but the short hydroperiod and frequent dry-outs should be fixed. A minimum objective would be to aim at conditions that are no worse than the 1995 and 2050 bases. This amounts to:

1. An increase to a minimum of 85% average annual inundation; and
2. A reduction in the frequency of dry-downs to below -1.0 ft to less than 5% of time. These would be non-ideal conditions for WCA-2B, but they would at least avoid conditions worse than those without-project, and would protect the marsh from severe over-drainage.

Also note that during the wet season WCA-2B is below NSM, and WCA-2A above NSM, although the discrepancies and their expected consequences are not as dramatic as during the dry season. Nonetheless, it would not hurt to send more 2A water to 2B year round, so long as this did not interfere with other performance objectives for Alternative 6.

Holey Land and Rotenberger WMAs

Performance based comments:

In Holley Land WMA (Indicator Region 29), Alternative 5 has 26 inundation events averaging 55 weeks in length for a total of 88% of time. This is similar to the 1995 Base (27 events averaging 52 weeks; 88% of time) and is slightly drier than NSM (24 events averaging 60 weeks; 90% of time). Performance is similar to alternatives 3 and 4 and much improved over the wetter 2050 Base. In Rotenberger WMA (Indicator Region 28), Alternative 5 has 40 inundation events averaging 33 weeks duration for a total of 82% of time. The % inundation is not as good a match for NSM as in Alternative 3 or Alternative 4; however the number and duration of inundation events is more similar to NSM. There is substantial improvement over both the drier 1995 Base and the wetter 2050 Base.

Alternative 5 satisfactorily meets performance targets for high water criterion in Holley Land and Rotenberger. In both Indicator Regions 28 and 29, Alternative 5 shows much improvement in meeting performance targets for avoidance of low water extremes that promote peat oxidation and create risk of fires.

Performance Measures Used:

The Performance Measures used were those for Indicator Regions 28 and 29.

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands, NSM flood levels). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth
3. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

4. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 28 and 29
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 28 and 29
3. Inundation Pattern (1965-1995) for Indicator Regions 28 and 29
4. Stage Duration Curves for Indicator Regions 28 and 29

Recommendation:

Maintain the features responsible for this performance.

WCA-3A

Performance Based Comments:

Alternative 5 hydroperiod in northwest WCA-3A is very similar to NSM in Indicator Region 22 (95% inundation vs. NSM 94%), but a little drier in Indicator Region 20 (91% vs. NSM's 94%). Hydroperiod performance is marginally improved over alternatives 3 and 4, definitely improved over the 2050 Base (88% inundation in Region 20; 92% in Region 22), and dramatically better than the 1995 Base (81% in Region 20; 76% in Region 22). Alternative 5 has zero high water events in Region 22 (vs. NSM's one event), and two events (1% of time) in Region 20 (vs. NSM zero events). This is slightly worse than alternatives 3 and 4 (zero events in both Regions) and worse than the 1995 and 2050 bases which also have zero events in Region 22 and Region 20. Low water exceedence in Alternative 5 in northwest WCA-3A is similar to NSM in % of time with depths less than 1.0 ft below ground (2% for Region 20 = NSM 2%; 1% for Region 22 = NSM 1%). Performance is better than the 2050 Base (4% low water, both Regions) and much better than the 1995 Base (7% in Region 20; 12% in Region 22) and better than both alternatives 3 and 4 (2-3%). Mean duration of dry-downs below -1.0 ft averages five weeks, which is longer than desirable for protection of peat soils. However, current performance may be the best that can be achieved without requiring prolonged inundation that could promote cattail proliferation in this region.

Alternative 5 hydroperiod matches NSM in northeast WCA-3A, however this region (Indicator Region 21) has seven high water events averaging nine weeks duration for 4% of total time. This performance is substantially worse than alternatives 3 (two events; 1% of time) and 4 (five events; 2% of time), as well as the 1995 and 2050 bases (each with two events; 1% of time). It does not meet the NSM target (three events near 0% of time). Also in Indicator Region 21, Alternative 5 dries out more than 1.0 ft below ground on 15 occasions averaging six weeks duration (6% of time). This meets NSM criteria and is an improvement over Alternative 4 (17 events averaging seven weeks; 8% of time). However, performance is not as good as Alternative 3 (11 events; average five weeks; 3% of time) or the 2050 Base (11 events; average seven weeks; 5% of time). Although performance meets the NSM target, this frequency of dry-downs may be likely to lead to further loss of peat soils.

In east WCA-3A (S of Alligator Alley; E of Miami Canal, Indicator Region 19) Alternative 5 (95% inundation) is not as good a match for NSM (89%) as is Alternative 4 (91%) but is a better match than Alternative 3 (97%). Alternative 4 is a better match for NSM-like hydroperiods. This region is still way too wet. Indicator Region 19 in Alternative 5 has 31 events averaging 16 weeks for 31% of time. This is more than twice the frequency of high water in alternatives 3 and 4, and nearly three times that of 2050 Base (23 events; average eight weeks; 11% of time). It nonetheless is better than the 1995 Base. Note that the pattern of inundation in Alternative 5 is similar to that in southern WCA-3A (Indicator Region 14, 36% high water) and southern LNWR (Indicator Region 26) under the 1995 Base. Predicted flooding during the high water of 1995 actually exceeds that of the 1995 Base. Frequency of low water events for this region meets the NSM-based target of less than eight events of four weeks duration (2%), and is also better than Alternative 4.

Southern WCA-3A (Indicator Region 14) is inundated 96% of time in Alternative 5; this matches NSM (95%), is similar to Alternative 3 (96%), Alternative 4 (94%), and the 2050 Base (96%), and is an improvement over the 1995 Base (99%). South Central WCA-3A (Indicator Region 17) is inundated 96% of time; this is similar to the 1995 Base (95%) and Alternative 4 (95%), and slightly wetter than the adjusted NSM hydroperiod target of 94%. North Central WCA-3A (Indicator Region 18) is inundated 97% of time -- 5% longer than NSM and 6% longer than the 1995 and 2050 bases. Overall, southern WCA-3A may be slightly wetter than is desirable, especially in Indicator Region 18 near Alligator Alley. Alternative 5 has too much high water in Indicator Region 14; nine events averaging 14 weeks for 8% of total time. This is much worse than Alternative 4 (0% of time) and worse than the 2050 Base (5%) and Alternative 3 (5%). The NSM target is one event of three weeks duration (0%). Indicator Region 17 has 3% high water, which is similar to the 2050 Base, 1995 Base and Alternative 3, and not as good as Alternative 4 (1%). The adjusted target for Indicator Region 17 is < 1% of time. Indicator Region 18 has 2% high water; which is slightly higher than the 2050 Base and alternatives 3 and 4. The NSM target for Indicator Region 18 is zero. Overall, Alternative 5 does not meet NSM targets and does not perform as well as Alternatives 3 and 4. During 1994-1995 high rainfall period, Alternative 5 produces extreme depths in all three indicator regions, and is actually worse than the 1995 Base in Indicator Region 18. All three regions and generally meet target criteria for low water criterion.

Performance Measures Used:

The Performance Measures used were those for Indicator Regions 14,17-22

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands, NSM flood levels). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth
3. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were calculated, with a planning target of:(1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

4. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 14,17-22
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 14,17-22
3. Inundation Pattern (1965-1995) for Indicator Regions 14,17-22
4. Stage Duration Curves for Indicator Regions 14,17-22
5. Stage Duration Curve at Gage 3A-4
6. Ponding Depth Maps
7. Ponding Depth Difference Maps
8. Peak Stage Difference Maps

Recommendations:

Maintain model performance with respect to northwest WCA-3A. Reduce frequency of extreme high water in northeastern WCA-3A without increasing frequency of dry-outs. The stage duration curve is too steep in eastern WCA-3A (Indicator Region 19) and the area deviates greatly from NSM-like marsh hydrology. Reduce extreme high water. Reduce high water events in Indicator Region 18, possibly by adjusting L-67 weir design or operational rules. Bring 1994-1995 peak depths to NSM levels.

WCA-3B

Performance Based Comments:

Overall, Alternative 4 and 1995 Base are better matches for NSM hydroperiods in WCA-3B. Hydroperiod in Alternative 5 is 99%, which exceeds NSM target by 5%. This is similar to Alternative 3 (99% inundation). Alternative 5 has 7% high water; this is improved over Alternative 4 (9%) but not as good as Alternative 3 (4%) or either of the Bases. The 2050 and 1995 bases are closest to NSM target of 2%. Such high water would have negative ecological impacts, especially for tree islands. Alternative 5 has no low water events in WCA-3B; this meets all targets.

Performance Measures Used:

The Performance Measures used were those for Indicator Region 15 only.

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands, NSM flood levels). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time > 2.5 ft depth
3. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were calculated, with a planning target of: (1) minimize and (2) be less than or equal to NSM for each of three scores: # events; mean duration; and % of time < -1.0 ft depth.

4. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Region 15
2. Temporal Variation in Mean Weekly Stage for Indicator Region 15
3. Inundation Pattern (1965-1995) for Indicator Region 15
4. Stage Duration Curves for Indicator Region 15
5. Ponding Depth Maps
6. Ponding Depth Difference Maps
7. Peak Stage Difference Maps

Recommendations:

Reduce extreme high water.

Pennsuco Wetlands

Performance Based Comments:

Southern Pennsuco (Indicator Region 53) has an 87% hydroperiod; this does not match NSM (99%) but is improved over Alternative 4 (73%) and the 1995 and 2050 bases. Northern Pennsuco (IR 52) has a hydroperiod of 94%, which overshoots the NSM target of 89%.

Performance Measures Used:

1. Extreme High Water. (Indicator Regions 52 and 53).

Recommendations:

NSM targets for Pennsuco need review, because NSM predicts only 5% depths greater than 2.0 ft in the north, but 29% greater than 2.0 ft in the south.

Proposed Pennsuco targets:

1. Low water events should not exceed 1 event averaging 1 week or more for the simulation period. Low water events should not occur for more than 1% of a year.
2. Hydroperiod criteria - 16 events averaging 95 weeks; 95% hydroperiod.
3. High water events should not exceed 10% of time > 2.0 ft.

Overall Northern and Central Everglades
Landscape-level Evaluation

Performance Based Comments:

NSM output shows 61 events over the 31-year simulation during which the Ridge and Slough landscape became less than 99% inundated (experienced a drydown). These events lasted 56 days on the average. At this level of inundation, there are no close matches to NSM by alternatives 3, 4, 5 or either base case. All three alternatives and the 2050 Base case show the landscape becoming less than 99% inundated four times over the simulation period for an average of ~2,730 days (~7 years). In comparison, the 1995 Base case was less than 99% inundated two times over the simulation period for an average of 5,477 days. This indicates that

virtually all of the historical Ridge and Slough landscape remained inundated for most of the simulation period, whereas the alternatives and base cases do not maintain similar long duration spatial inundation patterns. However, at 80% of the landscape, drydown length and frequency in the alternatives and base cases are more in line with NSM values; 25 drydown events lasting an average of 47.84 days. Alternative 4 had 26 drydown events with an average length of 54.19 days compared to Alternative 5 with 23 drydown events averaging 48.70 days.

Performance Measures Used:

1. Pond Count Statistics: Drydown Length of remnant Everglades Ridge and Slough Landscape
2. Temporal Variation of Drydown for remnant Ridge and Slough Landscape

Recommendations:

Better match NSM inundation patterns throughout the landscape keeping within high and low depth criteria. This translates to keeping the more of the Ridge and Slough landscape wetter for a longer duration.

Subteam Issues:

The spatial extent of the remnant Everglades, as delineated for the pond count performance measure, includes areas outside the eastern levee (WPA designated natural areas). Alternative comparisons should note the difference in % of landscape inundation without these cells to account for the possibility that these areas are not to be considered for Ridge and Slough restoration. An inventory of these cells has been requested.

F. Southern Everglades and Florida Bay and Coastal Basins Subregion

Northeast Shark Slough

Performance Based Comments:

At high (wet season) stages, Alternative 5 was below both NSM and Alternative 4; at low (dry season) stages, Alternative 5 was equal to NSM and an improvement over Alternative 4. Average annual overland flows to NESS were lower than NSM in both the wet and dry seasons. Under Alternative 5, the number of dry downs in NESS was equal to that predicted by NSM and three times less than Alternative 4. Minimum water levels under Alternative 5 were equal to NSM. Under Alternative 5, wet season stage (Indicator Region 11) falls short of NSM, perhaps a result of either insufficient water storage upstream or lack of dry season seepage control. Under Alternative 5, hydroperiod differences in average dry (1991) and very dry (1989) years showed drier conditions than NSM in southern NESS.

Average annual flows south of Tamiami Trail, east of L-67 extension for Alternative 5 were reduced in the dry season compared with Alternative 4 and are significantly below NSM4.5 overland target flow levels for the dry season. Wet season flows were decreased east of L-67 extension from Alternative 4 to Alternative 5 and are fairly significantly lower than the NSM target.

For Indicator Region 11, Alternative 5 provided water depths during peak alligator mating season (April 15-May 14) that were similar to those under NSM, except for 5% of the 31-

year simulation period, when Alternative 5 dried the area. This is a significant improvement over all previous alternatives, including Alternative 4.

Performance Measures and Indicators Used:

1. Normalized Stage Duration Curve at NESRS-2 (R21, C24).
2. Average Annual Overland Flow South of Tamiami Trail, East of L-67 Ext.
3. Average Monthly Overland Flows South of Tamiami Trail, East of L-67 Ext.
4. Peak Stage Difference 0.5' lower than NSM.
5. Inundation Duration (# of Events) (Region 11).
6. Temporal Variation in Mean Weekly Stage for NE Shark Slough (Region 11).
7. Hydroperiod Differences (1989 and 1991).
8. Average Annual Hydroperiod Differences.
9. Average Water Depth during Peak Alligator Mating Period (April 15-May 14) (Region 11).

Recommendation:

Alternative 5 showed an improvement over Alternative 4, especially with regard to dry season flows. Compared with NSM, wet season flows were still lower, but dry season flows were similar.

Shark River Slough

Performance Based Comments:

In a dry year, NSM predicts a persistent pool aligned along the main stem of the historic Shark Slough in accordance with natural topographic contours. The cessation of sufficient overland flow into Shark Slough has resulted in the reduction or elimination of persistent pooling, as well as increased frequency of dry downs, affecting survival and productivity of aquatic organisms.

Hydroperiods predicted by Alternative 5 were close to NSM (as in Alternative 4), but flows were slightly lower. Stage duration curves at five hydrological stations throughout Shark Slough showed lower or similar stages in Alternative 5 compared with NSM, and were an improvement over Alternative 4. As in Alternative 4, Alternative 5 resulted in about twice as many drydown events compared with NSM during the 31-year simulation period for Indicator Regions 9 and 10 in Shark Slough; however, drydown events for Indicator Region 12 were equal to NSM and only slightly less than Alternative 4. For Indicator Region 10, the number of weeks water depths exceeded 2.5 ft was about four times as great under NSM as in Alternatives 4, whereas the number of weeks that depths were lower than -1 ft was three times greater under Alternative 5 than NSM, an improvement over Alternative 4. Alternative 5, as in Alternative 4, revealed lower natural variability in hydropatterns than under NSM.

Average monthly and annual overland flows to ENP showed slightly lower volumes of water going south of the Tamiami Trail under Alternative 5 when compared with NSM and Alternative 4. Under Alternative 5, flows west of the L-67 extension canal were similar to NSM flows during the dry season, but were less than NSM during the wet season, a condition equivalent to Alternative 4.

Why are conditions in Indicator Regions 9 and 10 drier than NSM under Alternative 5, whereas the information indicated by water volume flowing across the Tamiami Trail and flow vector lines show the opposite condition?

For Indicator 10, Alternative 5 provided water depths during peak alligator mating season (April 15-May 14) that were slightly lower than NSM, except for 7% of the 31-year simulation period, when Alternative 5 dried the area. This is an improvement over all previous alternatives. For Indicator Region 9, Alternative 5 provided water depths during peak alligator mating season (April 15-May 14) that were considerably lower than NSM; 20% of the 31-year simulation period under Alternative 5 dried the area. This condition does not differ significantly from alternatives 4 and 3.

Performance Measures and Indicators Used:

1. Stage Duration Curves NP-201, P-33, G-620, NP-34, NP-38
2. Average Monthly Overland Flows S. of Tamiami Trail, West of L67 Extension.
3. Normalized Weekly Stage Duration Curves for Mid Shark River Slough (Region 10).
4. Inundation Summary Table (# of events) (Regions 9, 10, 12).
5. Temporal Variation (std. dev.) in mean weekly stage for Shark Slough (Regions 10, 12).
6. Average Annual Overland Flow South of Tamiami Trail, West of L-67 Extension.
7. Average Annual Hydroperiod Differences.
8. Average Water Depth during Peak Alligator Mating Period (April 15-May 14) (Regions 9, 10).

Recommendation:

Increase storage capacity north of the Everglades Protection Area in order to produce stages and persistent dry season pools that closely match NSM.

Marl Lands West of Shark River Slough (Indicator Region 46)

Performance Based Comments:

Under Alternative 5, as in Alternative 4, stage duration was similar to that predicted by NSM, with a similar number of dry-down events.

Performance Measures and Indicators Used:

1. Stage Duration Curves for Marl Lands West of Shark River Slough, Gage NP-34.
2. Inundation Summary Table (# of events) (Region 46).
3. Stage Duration Curve for Cape Sable Sparrow West (Region 46).

Recommendation:

Alternative 5, like Alternative 4, showed hydrologic improvement, approaching NSM conditions for all parameters.

Rocky Glades/Eastern Marl Prairies

Performance Based Comments:

Although Alternative 5, like Alternative 4, provided some improvement over the various base alternatives, it fell significantly short of restoration targets when compared with NSM. For example, at gage G-596, NSM predicts flooding of the area for 75% of the simulation period,

whereas Alternative 5 (as in Alternative 4) showed almost no surface water for the same period. Average annual hydroperiods under Alternative 5 were similar to both NSM and Alternative 4. In an average year (1991), hydroperiods were equal to NSM in the south, but less than NSM in the north. Ponding depth differences indicated no difference between Alternative 5, Alternative 4, and NSM; however, stage duration curves are not in agreement with this output. Subsurface water levels during the dry season are significantly lower than predicted for NSM; this has serious consequences for solution hole refugia. Under NSM, temporal variability in stage at the beginning of the wet season is greater than that seen under the alternatives.

Restoration needs to provide longer continuous hydroperiods, greater ponding depths, and more frequent occurrence of multi-year continuous inundation.

Performance Measure and Indicators Used:

1. Marsh Stage Duration Curves (G-596, Region 8).
2. Temporal Variation in Mean Weekly Stage for Rockland Marl Marsh (Region 8).
3. Hydroperiod Differences (1991).

Recommendation:

Increase the inflow to the Rocky Glades, especially during the dry season.

Taylor Slough

Performance Based Comments:

There were no differences in ponding depths or average annual hydroperiods between Alternative 5, Alternative 4, and NSM, except along the L-31 canal where they were less than NSM. The subteam questions the reliability of NSM output for Taylor Slough. In Indicator Region 1, the temporal patterns in mean weekly stage and in the variability of those stages were less than NSM during the dry season but similar during the wet season, whereas in Indicator Region 3, these patterns and their variability under Alternative 5 were less than NSM, a condition similar to Alternative 4.

Performance Measures and Indicators Used:

1. Stage duration curves at Taylor Slough Bridge (Gage THSO).
2. Temporal variation in mean weekly stage for Taylor Slough (Region 1).
3. Normalized weekly stage duration curve for mid Perrine Marl Marsh (Region 3).
4. Temporal variation (std. dev.) in mean weekly stage for Region 3.
5. Average Annual Hydroperiod Differences.

Recommendation:

Available output for Taylor Slough indicates that more water is needed during the dry season.

Note:

The output provided for Taylor Slough was not adequate for the subteam to make a complete assessment of the alternative. Models runs for more stations within Taylor Slough are needed.

C-111 Basin

Performance Based Comments:

Alternative 5 has improved the hydropattern of the area, in that the frequency of dry-down events is similar to NSM. However, the weekly stage duration curve for Indicator Region 4 shows consistently greater stages than predicted by NSM (but this was lower than Alternative 4). Conversely, stage duration curves at gage G-1251 showed stages consistently lower than NSM, also predicted by Alternative 4, perhaps because of canal drainage. Under Alternative 5, stage for Indicator Region 47 was less variable in the dry season compared to NSM but more variable than NSM during the wet season. In Indicator Region 47, there was an increase in wet season water depths in most years, which is desirable (however, dry season water depths were lower than NSM). The additional water moving into Region 47 via the C-111N moves the hydroperiod closer to the nine months desired in a marl prairie. Under Alternative 5, the number of drydown events in Indicator Region 4 were equal to those predicted by NSM and Alternative 4. However, the number of drydown events under Alternative 5 (as in Alternative 4) in Indicator Region 47 was greater than under NSM.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Duration Curves (Region 4).
2. Stage Duration Curve (G-1251).
3. Peak Stage Difference 1.0' higher than NSM.
4. Temporal variation (std. dev.) in mean weekly stage for C-111 Perrine Marl Marsh (Region 4).
5. Temporal Variation (std. dev.) in Mean Weekly Stage for North C-111 (Region 47).
6. Inundation Duration Summary (Region 47).
7. Weekly Stage Duration Curve for North C-111 (Region 47).

Recommendations:

Sheetflow must be reestablished in the C-111 Basin, including filling in canals, ditches, and culvert pools to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Model Lands

Performance Based Comments:

Alternative 5, like Alternative 4, showed definite improvement for stage duration curves over base conditions and previous alternatives in Model Lands South (Region 5). Stages in the southern Model Lands were higher than NSM and Alternative 4 in both wet and dry seasons; however, variability in stage was greater under NSM than Alternative 5. Average annual hydroperiod differences were equal to NSM in the south (Indicator Region 5), but greater than or equal to NSM in the north (Indicator Region 6). Stages in the northern Model Lands were much less than stages under NSM. Under Alternative 5, Indicator Region 6 had twice as many dry-down events as NSM, while Indicator Region 5 had less than NSM. Dry downs would have significant negative effects on aquatic organisms and associated ecological processes.

Performance Measures and Indicators Used:

1. Stage Duration Curves for Model Lands South (Region 5) and North (Region 6).

2. Stage Duration Curves (R8, C29).
3. Peak Stage Difference 0.5' lower than NSM.
4. Temporal Variation (S.D.) in Mean Weekly Stage Model Lands North (Region 6).
5. Inundation Summary Table (#of events) (Region 6).

Recommendation:

The basin is closed and ecologically degraded, lacking connection with adjacent wetlands to the west. The significant reduction in spatial extent of the historic natural system requires that efforts be made to restore these wetlands. Explore strategies to improve the timing and distribution of water deliveries to the Model Lands. Decompartmentalize within the Model Lands. Model with and without reused water, in order to see whether modifications to the C-111N have any additional benefits in Indicator Region 6. DERM recommends that alternative sources of water, other than treated wastewater, be modeled for this region, in order to provide practical options if reuse concerns cannot be settled. They suggest that the use of treated wastewater to enhance wetland functions and freshwater deliveries to Biscayne Bay is not a guaranteed option at this time. Concerns have been raised on water quality issues and cost issues. Either of these issues is sufficiently serious that there is a good possibility that reuse would not prove to be a viable additional source of water.

General Comments on Alternative 5 for the Southern Everglades:

Alternative 5 presented some reversal of partial decompartmentalization in Alternative 4, in which internal canals were filled in and levees were degraded in the southern part of the system. The subteam evaluated the hydrological effects of Alternative 5, and evaluated the available ecological output. The subteam predicts that ecological benefits will result from the decompartmentalization that was modeled. Alternative 5 produced hydrological conditions that approached NSM closely in some areas and in certain parameters, but the subteam continues to observe problems in dry season stages and the increased frequency of drydown events that deviated from NSM. The subteam attributes the lack of concordance with NSM to insufficient flows from areas north of the Southern Everglades. The subteam strongly endorses filling of all canals and removal of levees within the Everglades Protection Area in Alternative 6, with sufficient clean water supply to ensure that NSM targets are met in the southern part of the system. For Alternative 6, the subteam endorses the removal of the S-12 structures and L-28, as in Alternative 4, and, if needed, model the presence of elevation control weirs along the L-67A alignment to provide persistent dry season flows southward.

Note:

In the 1984 memorandum that introduced the 7-Point Plan proposed by Everglades National Park, the major recommendations for hydrologic restoration of the Shark Slough Basin included the degradation of levees and filling of canals, establishment of a rainfall-driven system, and the reestablishment of sheet-flow. The ecological benefits of these hydrological actions included: (1) the reestablishment of connections between isolated basins to permit movement by aquatic animals, thereby reducing the isolation of populations; and (2) filling in canals and ditches to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Note:

A general assessment of Alternative 5, like Alternative 4, indicated that a number of structures (e.g., curtain walls and new structures) have been added. Some progress was made toward decompartmentalization of the system, but many structures and canals are still present in the model for the Everglades Protection Area and the C-111 and Model Lands areas. More effort should be made to fill canals and ditches and to remove levees whenever possible.

Recommendation:

Alternative 5 advanced the cause of ecological restoration that has been advanced by the Southern Everglades DOI team in some areas, but was a step backwards in others. Alternative 6 should represent the complete ecological restoration that will include a major emphasis on decompartmentalization.

NORTHEAST SHARK RIVER SLOUGH (INDICATOR REGION 11)

Three priority hydrologic performance measures for the ecological restoration of Northeast Shark River Slough are identified in the Everglades Sloughs Conceptual Model. Those measures, in order of priority, are the duration of uninterrupted flooding, the maximum depth to which the water table drops during drought periods, and the water depth during periods of flooding.

The NSM indicated that Northeast Shark River Slough would have dried only once during the 31-year period of record, yielding uninterrupted periods of inundation that averaged more than 15 years. Water depths averaged nearly two feet during periods of flooding, and the water table dropped to less than a foot below ground during the single drought period. Persistent flooding in Northeast Shark River Slough influenced hydropattern in the adjacent Mid Shark River Slough and Rockland Marl Marsh, provided a drought refugium for aquatic fauna in the adjacent regions, and influenced salinity in the coastal basins of Florida Bay through its hydrologic effects on Mid Shark River Slough (P33 Gage) and the Rockland Marl Marsh (Taylor Slough headwaters).

The 1995 Base and 2050 Base indicated severely over-drained conditions in Northeast Shark River Slough. The average period of uninterrupted flooding was reduced to less than 1.5 years ($1/10^{\text{th}}$ of NSM) because the marsh dried 18-22 times during the period of record. Water depths averaged less than one foot during periods of flooding, and the water table dropped to more than two feet below ground during extreme drought conditions.

Alternative 5 was by far the best alternative to date regarding the performance measure of duration of uninterrupted flooding. Periods of flooding that averaged 7.5 years were interrupted by only three drydowns. The best alternative prior to Alternative 5 was the Starting Point. Alternative 5 was also successful in limiting the depth to which the water table dropped during drought periods to the NSM level of approximately one foot. Alternative 3 and Starting Point were also successful regarding this measure. Alternative 5 was one-half foot deficient compared to NSM regarding mean water depth during periods of flooding. All previous alternatives also showed depth deficiencies equal to, or greater than, Alternative 5.

NORTHEAST SHARK RIVER SLOUGH INDICATOR REGION 11. PRIORITY HYDROLOGIC PERFORMANCE MEASURES FROM ECOLOGICAL CONCEPTUAL MODEL ARE HIGHLIGHTED.

	<u>WET CONDITIONS</u>			<u>DRY CONDITIONS</u>	
	Total Duration Weeks	Mean Duration Weeks	Mean Depth Feet	Number of Drydowns	Max. Depth BG Feet Average(Maximum)
NSM45	1611	806	+1.8	1	-0.9 (-0.9)
95BASE	1381	66	+0.8	22	-0.9 (-2.2)
50BASE	1376	76	+0.9	18	-1.1 (-2.2)
STRTPPT	1572	196	+1.2	7	-0.7 (-1.2)
ALT1	1464	98	+1.1	15	-0.8 (-1.8)
ALT2	1495	93	+1.0	16	-0.6 (-1.7)
ALT3	1557	142	+1.2	10	-0.5 (-1.1)
ALT4	1500	115	+1.2	12	-0.8 (-1.8)
ALT5	1587	397	+1.3	3	-0.8 (-1.1)

MID SHARK RIVER SLOUGH (INDICATOR REGION 10)

Three priority hydrologic performance measures for the ecological restoration of Mid Shark River Slough are identified in the Everglades Sloughs Conceptual Model. Those measures, in order of priority, are the duration of uninterrupted flooding, the maximum depth to which the water table drops during drought periods, and the water depth during periods of flooding.

The NSM indicated that Mid Shark River Slough would have dried only three times during the 31-year period of record, yielding uninterrupted periods of inundation that averaged nearly eight years. Water depths averaged approximately 1.5 feet during periods of flooding, and the water table dropped to less than a foot below ground during the drought periods. The duration and depth of flooding provided a drought refugium for aquatic fauna in adjacent regions and influenced salinity in the coastal basins of Florida Bay (based on P-33 stage/coastal basin salinity relationships).

The 1995 Base and 2050 Base indicated that the average period of uninterrupted flooding in Mid Shark River Slough was reduced to less than two years (1/4th of NSM) because the marsh dried 15 times during the period of record. Water depths averaged one foot during periods of flooding, and the water table dropped two feet below ground during extreme drought conditions.

Alternative 5 and Alternative 4 were the best alternatives to date, and were approximately equal, regarding the performance measure of duration of uninterrupted flooding. Periods of flooding that averaged ~3.3 years were interrupted by eight drydowns. The best alternative prior to alternatives 5&4 was the Starting Point. Alternative 5 was the only alternative that was successful in limiting the depth to which the water table dropped during drought periods to the NSM level of approximately one foot. All alternatives, including Alternative 5, remained approximately one-half foot deficient in mean water depth during periods of flooding. This deficiency related to the P-33 Gage stage deficiencies that were indicated by the P-33 stage/coastal basin salinity relationships.

MID SHARK RIVER SLOUGH INDICATOR REGION 10. PRIORITY HYDROLOGIC PERFORMANCE MEASURES FROM ECOLOGICAL CONCEPTUAL MODEL ARE HIGHLIGHTED.

	<u>WET CONDITIONS</u>			<u>DRY CONDITIONS</u>	
	<u>Total Duration Weeks</u>	<u>Mean Duration Weeks</u>	<u>Mean Depth Feet</u>	<u>Number of Drydowns</u>	<u>Max. Depth BG Feet Average(Maximum)</u>
NSM45	1608	402	+1.6	3	-0.4 (-0.9)
95BASE	1497	92	+1.0	15	-1.0 (-2.0)
50BASE	479	92	+1.0	15	-1.0 (-1.9)
STRTPPT	1537	154	+1.1	9	-1.0 (-1.7)
ALT1	1531	128	+1.0	11	-0.9 (-1.7)
ALT2	1533	139	+1.1	10	-1.0 (-1.7)
ALT3	1545	140	+1.0	10	-0.8 (-1.7)
ALT4	1539	171	+1.2	8	-1.0 (-1.7)
ALT5	1576	175	+1.1	8	-0.5 (-1.2)

ROCKLAND MARL MARSH (INDICATOR REGION 8)

Three priority hydrologic performance measures for the ecological restoration of the Rockland Marl Marsh are identified in the Marl Prairie/Rocky Glades Conceptual Model. Those measures, in order of priority, are the duration of uninterrupted flooding, the maximum depth to which the water table drops during drought periods, and the water depth during periods of flooding.

The NSM indicated that the Rockland Marl Marsh would have dried 29 times during the 31-year period of record, yielding uninterrupted periods of inundation that averaged approximately 8.5 months. Water depths averaged 0.5 feet during periods of flooding, which is the minimum level identified in the conceptual model to sustain viable populations of marsh fishes. The water table dropped to nearly four feet below ground during drought periods. The duration and depth of flooding influenced salinity in the coastal basins of Florida Bay, since the Rockland Marl Marsh is the headwaters of the Taylor Slough watershed.

The 1995 Base indicated severely over-drained conditions in the Rockland Marl Marsh that probably were related to the severe over-drainage in Northeast Shark River Slough immediately to the north. The average period of uninterrupted flooding was reduced to approximately two months ($< 1/4^{\text{th}}$ of NSM) because the marsh dried 46 times during the period of record. Water depths averaged only 0.2 feet during periods of flooding, which was far less than that required for viable marsh fish populations. The water table continued to drop approximately four feet below ground during extreme drought conditions. The 2050 Base showed slight improvements over 1995 Base that probably resulted from the C-111 GRR.

All alternatives to date were similar regarding the performance measure of duration of uninterrupted flooding, although Alternative 5 was slightly better than the others. Periods of flooding that averaged approximately 6.6 months were interrupted by 34 drydowns. The best alternative prior to Alternative 5 was Alternative 3. Alternative 5 was the most successful of the alternatives in limiting the depth to which the water table dropped during drought periods. All alternatives, including Alternative 5, were successful in maintaining a mean depth of approximately 0.5 feet during periods of flooding.

ROCKLAND MARL MARSH INDICATOR REGION 8. PRIORITY HYDROLOGIC PERFORMANCE MEASURES FROM ECOLOGICAL CONCEPTUAL MODEL ARE HIGHLIGHTED.

	<u>WET CONDITIONS</u>			<u>DRY CONDITIONS</u>	
	Total Duration Weeks	Mean Duration Weeks	Mean Depth Feet	Number of Drydowns	Max. Depth BG Feet Average(Maximum)
NSM45	1052	36	+0.5	29	-1.8 (-3.8)
95BASE	405	9	+0.2	46	-1.7 (-4.1)

50BASE	735	19	+0.4	39	-1.9 (-4.0)
STRTPPT	880	25	+0.5	35	-2.0 (-3.9)
ALT1	860	26	+0.5	33	-2.0 (-3.9)
ALT2	870	25	+0.5	35	-2.0 (-3.9)
ALT3	1020	27	+0.5	38	-1.7 (-3.9)
ALT4	981	26	+0.5	37	-1.7 (-3.7)
ALT5	968	28	+0.5	34	-1.8 (-3.5)

FLORIDA BAY AND COASTAL BASINS P-33 STAGE/SALINITY RELATIONSHIPS

P-33 stages above 6.3 feet msl correspond to a reduced frequency of undesirable high salinity events in coastal basins of Florida Bay. There are approximately 49 months of the 372-month period of record when NSM4.5 exceeds that stage, but Alternative 5 does not.

P-33 stages above 7.3 feet msl correspond to an increased frequency of desirable low salinity events in coastal basins of Florida Bay. There are approximately 22 months of the 372-month period of record when NSM4.5 exceeds that stage, but Alternative 5 does not.

Alternative 5 resulted in deficiencies in 6.3+ stages most frequently during January. Alternative 5 resulted in deficiencies in 7.3+ stages most frequently during July, September and October.

THE NUMBER OF MONTHS DURING THE 372 MONTH PERIOD OF RECORD WHEN NSM4.5 EXCEEDS STAGES OF 6.3 AND 7.3 FEET MSL, BUT THE BASE CONDITIONS AND ALTERNATIVES DO NOT. THE MONTHS WHEN THE 6.3 AND 7.3 DEFICIENCIES OCCURRED MOST FREQUENTLY ARE GIVEN IN PARENTHESES.

	<u>6.3 FEET MSL</u>		<u>7.3 FEET MSL</u>	
95BASE	140	(Dec-Feb)	44	(Sep-Oct)
50BASE	108	(Jan-Feb, Jun)	46	(Sep-Oct)
STRTPPT	57	(Jan-Feb)	23	(Sep-Oct)
ALT1	78	(Jan-Feb)	34	(Sep-Oct)
ALT2	67	(Jan-Mar)	29	(Sep-Oct, Jun)

ALT3	48	(Jan-Feb, Jun)	16	(Oct-Nov, Jul)
ALT4	53	(Jan)	19	(Sep-Nov, Jul)
ALT5	49	(Jan)	22	(Sep-Oct, Jul)

G. Caloosahatchee & St. Lucie Estuaries, Lake Worth Lagoon, and Biscayne Bay Subregion

See the subteam's highlights report.

H. Big Cypress Subregion

In all cases targets were conditions predicted by the Natural System Model (NSM).

Performance Based Comments

South Florida Maps

ANNUAL AVERAGE HYDROPERIOD DIFFERENCES relative to the NSM showed considerable improvement in Alternative 5, with the vast majority of the region having NSM hydroperiods, and much of the remainder being only 30-60 days shorter than NSM. The NSM conditions first restored in Alternative 4 in the gap between the north and south ends of L-28 have been maintained with minor shifts among the cells. The drier-than-NSM conditions to the west of the south end of L-28 in all previous alternatives and the 2050 Base have returned to NSM conditions, except for a small drier (mostly 30-60 days shorter) area in the vicinity of the L-28 Tieback. The drier (30-60 days shorter) area that appeared in the east end of the Loop south of Tamiami Trail in Alternative 4 has returned to NSM conditions. The greatest change in Alternative 5 was along the L-28 Interceptor. Hydroperiods just downstream of the new S-190 pump station at the top of the filled L-28 Interceptor Canal were actually 60-120 days longer than NSM on the west side of the remaining L-28 Interceptor levee. This was probably a result of water flowing south to the new S-190 pump and then accumulating just downstream of the pump. As one continues south along the west side of the L-28 Interceptor, hydroperiods approach and finally attain NSM conditions just north of I-75. It was interesting that at a distance of about four miles west of the L-28 Interceptor alignment, Alternative 5 hydroperiods match conditions in all of the previous alternative and base scenarios, despite the partial-to-full degradation of the south levee along the Western Feeder Canal. This suggests that the drier-than-NSM conditions along this northern boundary may be a result of model boundary characteristics, rather than actual drainage impacts, just as seems to have occurred along the western model boundary in the Big Cypress. The developed lands bounded by the L-28 Interceptor and L-28 North have remained drained.

The Alternative 5 Decompartmentalization scenario reestablished the 30-60 days shorter-than-NSM hydroperiod conditions in the area from L-28 southwest to Tamiami Trail and in a small area at the eastern end of the Loop south of Tamiami Trail. Otherwise, ANNUAL

AVERAGE HYDROPERIOD DIFFERENCES relative to the NSM were similar to Alternative 5.

Relative to the 2050 Base, HYDROPERIOD BENEFITS / IMPACTS in the Big Cypress from the Starting Point, alternative 1 or 2 scenarios were restricted to the southeast corner of the area and were minor and very scattered. Alternatives 3 and 4 overshoots occupied a large portion of this same area, although they were generally of less than 30 days duration. In Alternative 4, there was a small portion of the eastern Loop where conditions were significantly worse compared to the 2050 Base condition. In Alternative 5, HYDROPERIOD BENEFITS / IMPACTS, relative to the 2050 Base, returned to being minor and scattered in the southeast corner of the Big Cypress. Hydroperiods in alternatives 4 and 5 were improved over a large area from the southern end of the L-28 Interceptor to the northern end of L-28 Tieback, most likely associated with the additional amounts of water being brought south into this area by the L-28 North canal. Alternative 5 hydroperiods were also quite different in the area along both sides of the L-28 Interceptor, particularly above I-75. In the vicinity and for about five miles downstream of the new S-190 pump, there were >30 day NSM overshoots on the west side of the remaining levee. This area was surrounded by <30 day NSM overshoots to the north, south, and west, and “improved” conditions to the east. There is definitely too much water just below the new S-190 pump.

The Alternative 5 Decentralization scenario reestablished the <30 day NSM overshoot in the southeastern corner of the Big Cypress below Tamiami Trail, but otherwise HYDROPERIOD BENEFITS / IMPACTS were similar to Alternative 5.

PONDING DEPTH DIFFERENCES within the Big Cypress, when compared to NSM conditions were generally similar between all alternatives and base condition scenarios. The only change even near the Big Cypress occurred in alternatives 4 and 5, when 0.5-2.0 feet deeper water was present along the lower end of L-28 North, and was associated with water moving into the area in the L-28 canal. PONDING DEPTH DIFFERENCES in Alternative 5 Decentralization scenario were the same as for Alternative 5.

Relative to NSM, there are some FREQUENCY OF PEAK STAGE DIFFERENCES between alternatives 3, 4, and 5 that are relevant to the Big Cypress in the vicinity of its boundary with the Everglades. There was a small reduction in the area that had been showing a slightly higher frequency of lower peak stages along the southeastern boundary below Tamiami Trail in both alternatives 4 and 5 compared to Alternative 3. The reduction in the frequency of higher peak stages in the lower end of WCA-3A that occurred in Alternative 4 has been reversed in Alternative 5 to approximately what it had been in Alternative 3. The increased frequency of higher than NSM peak stages in the central portion of WCA-3A in the vicinity of the L-28 gap, which occurred in Alternative 4, has been maintained in Alternative 5. There is an increased frequency of higher than NSM peak stages along the L-28 Interceptor, particularly in the vicinity of the new S-190 pump station, and just west of the gap between L-28 North and South.

Indicator Regions

The Normalized Weekly Stage Duration Curves were the initial and primary performance measure by which the Indicator Regions were evaluated. If these proved to be distinctly

different for this alternative from previous alternatives, Temporal Variation in Mean Weekly Stage was looked at. If the latter proved to be distinctly different for this alternative from previous alternatives, the Normalized Weekly Stage Hydrograph was looked at next.

For many of the Big Cypress Indicator Regions, there were no significant changes in hydrology from conditions in alternatives 3, 4, or 5. Most differences were non-existent (Indicator Regions 32-35, 41, 44) or minor in the range of 0.05-0.15 feet (Indicator Regions 31, 36-40, 45). West Slough (Indicator Region 13), which had been up to 0.3 feet higher than NSM in alternatives 1 and 2 and very close to NSM in Alternative 3, as much as 0.2 feet below NSM in Alternative 4, was generally 0.05-0.15 feet higher than NSM in Alternative 5. In NE Big Cypress (Indicator Region 42), there were significant improvements in water levels, particularly when the water table was below ground. When the water table was above ground, water levels were only about 0.2 feet below NSM in the other alternatives and bases, and Alternative 5 improved this slightly to about 0.15 feet below NSM. However, below ground water levels were as much as 0.6 feet below NSM in the other alternatives and bases, but only as much 0.25 feet below NSM in Alternative 5. In the Northeast Corner of Big Cypress (Indicator Region 43), Alternative 5 showed major improvements of 0.2-1.4 feet over the other alternative and base water levels when the water table was above ground. At these times water levels were within 0.3-0.6 feet of NSM. However, as the water table declined below ground it came steadily closer to the other alternatives and bases, until it was in their same range at about 2.5 feet below ground.

In comparing Alternative 5 with NSM, the same pattern is still reported, as was found for alternatives 3 and 4, with indicator regions in the central (32, 33) and southwestern (44) portions of the area showing no real differences; those in the southern (40) and northwestern (41) portions showing minor differences of 3-7% reductions in hydroperiods and up to 0.1-0.3 feet lower-than-NSM water levels. The more severe reductions in hydroperiods (33-47%) and water levels (up to 2.0 feet) seen along the west boundary (Indicator Regions 34, 35) are still present and are still likely to be more a result of model problems than real world problems. While the NE Corner Big Cypress Indicator Region (43) still has severe biologically-significant reductions in hydroperiods (29%) and water levels (up to 1.5 feet) in Alternative 5, these represent significant improvements from the 70% reduction in hydroperiod and up to 2.5 feet reduction in water levels that existed in all other alternatives and bases. Improved hydroperiod (from 19% to 9%) and water levels (0.2-0.6 feet below NSM to 0.15-0.25 feet below NSM) in Alternative 5 in the NE Big Cypress Indicator Region (42) has resulted in comparable hydrologic conditions to the other Indicator Regions in the area along the eastern boundary of the Big Cypress from Mullet Slough south to Tamiami Trail (31, 36-39, 45). These Indicator Regions also have improved hydroperiods (by 1-5%) and water levels (by <0.1 feet) in Alternative 5 compared to other alternatives and bases, such that they probably no longer represent biologically-significant reductions in hydroperiod (1-8%) and water levels (up to 0.05-0.25 feet). The West Slough Indicator Region (13) has shown a variety of changes in recent alternatives. Prior to Alternative 3 hydroperiods were 8% higher than NSM and water levels were up to 0.3 feet higher. In Alternative 3, the hydrology was essentially comparable to NSM, while in Alternative 4, hydroperiods are 5% less than NSM and water levels are up to 0.2 feet lower than NSM. Alternative 5 hydrology is again more similar to Alternative 3, with hydroperiods only 3% more than NSM and water levels at most about 0.15 feet higher than NSM.

The Alternative 5 Decompartmentalization produced few and only minor differences from Alternative 5. The greatest differences were in the West Slough Indicator Region (13), where it was consistently similar to or slightly below (up to 0.1 feet) NSM water levels, while Alternative 5 was normally up to 0.05-0.15 feet above NSM.

Big Cypress National Preserve

With Alternative 5, hydroperiods in more than half (61%) of the North Big Cypress matched NSM conditions, as compared to less than half in all of the previous base and alternative scenarios (46-49%). Most of the non-matching acres had 30-90 day shorter hydroperiods, but for about 10% of the acres, hydroperiods were 90-180 days shorter. The improvement of 3% in Alternative 4 was associated with increased water in lower Mullet Slough, that is being brought into the area by the L-28 Canal, and which continues in Alternative 5. The 11% improvement in Alternative 5 is due largely to changes in design of the L-28 Interceptor and Western Feeder Canal in the northeastern Big Cypress. There was a small portion of the area, where hydroperiod changes overshot NSM conditions by more than 30 days. This occurred in the vicinity of the new S-190 pump station, where there were 60-120 days longer-than-NSM hydroperiods.

Until Alternative 5, in the South Big Cypress there were small differences among the scenarios, with only about 10-15% of the area being different from NSM, and most of those deviations being only 30-90 days longer or shorter. The 30-90 day longer-than-NSM hydroperiods that appeared to be associated with the adjacent Everglades in earlier scenarios were eliminated in Alternative 3, while the shorter-than-NSM hydroperiods that appeared to be associated with the area southwest of the north end of L-28 had not changed. In Alternative 4, the area with 30-90 day shorter-than-NSM hydroperiods had increased by about 5%, primarily in the area to the west of L-28 and in the eastern portion of the Loop. In Alternative 5, 98.6% of the South Big Cypress matched NSM.

Average overland flows to the Gulf of Mexico in the Big Cypress still show substantial spatial variability, although within the western and eastern Big Cypress cross-sections, flows predicted by all of the base and alternative scenarios were similar to one another but different from the NSM. In the western Big Cypress National Preserve, dry season flows were similar among all scenarios, except NSM which had about 50% more flow than the other scenarios during the wet season. In the eastern Big Cypress National Preserve both wet and dry season flows were about 50% higher in the NSM than all other scenarios.

In the Lostman's area, next to the Everglades, flows were substantially higher among all base and pre-Alternative 4 scenarios during both wet and dry seasons than for the NSM. There is also more scenario-to-scenario variability in the Lostman's area than for either of the other Big Cypress flow cross-sections, because of the greater amount of hydrologic manipulation among the various scenarios in the Everglades as compared to the Big Cypress. Alternative 3 showed substantial improvement over Alternative 2 in returning both wet and dry flows to a condition more comparable to that seen in the NSM scenario. This was particularly evident in the period from January through August. Alternative 4 has produced substantially lower than NSM flows

throughout the year. Alternative 5 has resulted in even closer to NSM flows than did Alternative 3, although wet and dry season flows were still slightly higher than NSM.

Conclusions

In general, given where most of the component changes have been made in the South Florida ecosystem and that the Big Cypress is very much a separate watershed from the Everglades, it is not surprising that the structural and operational changes made in all of the alternatives have primarily affected lands only in the eastern portion of the Big Cypress along its boundary with the Everglades. Replacing the L-28 South and L-29 (western portion) seems to have helped the hydrology of the southeastern portion of the Big Cypress. Changes in the L-28 Interceptor and Western Feeder Canal in the northeast Big Cypress appear to have significantly improved conditions throughout the eastern portion of the Big Cypress. Reducing the accumulation of water downstream of the new S-190 pump station would help to improve conditions in this area, as well as provide water to areas further downstream that are still too dry.

Performance Measures and Indicators Used

- Hydroperiod Distribution Maps
- Hydroperiod Improvement Maps
- Hydroperiod Differences Maps
- Ponding Depth Maps
- Ponding Depth Differences Maps
- Peak Stage Differences Maps (NSM)
- Indicator Regions in or near Big Cypress (13, 31-45)
 - Weekly Stage Hydrographs
 - Weekly Stage Duration Curves
 - Temporal Variation of Stage
- Big Cypress National Preserve
 - North and South Big Cypress National Preserve
 - NSM and 50B hydroperiod matches
 - Average wet/dry season flows toward Gulf of Mexico
 - western Big Cypress National Preserve
 - eastern Big Cypress National Preserve
 - Lostman's
 - Average monthly overland flows toward Gulf of Mexico
 - western Big Cypress National Preserve
 - eastern Big Cypress National Preserve
 - Lostman's

Problem Identification

Until Alternative 5, the Annual Average Hydroperiod Difference maps have consistently shown much drier than NSM conditions in a large area in the northeast corner of the Big Cypress. Alternative 5 degraded the levee along the southwest side of the L-28 Interceptor Canal and filled the canal south from the S-190. The S-190 was converted to a pump station to maintain drainage in the area upstream of the S-190. The levee along the northeast side of the canal was retained to protect drained lands between the L-28 Interceptor and L-28 North. In

Alternative 5, this arrangement produced much longer-than-NSM hydroperiods and higher peak stages in the vicinity and downstream of the S-190 pump station. It is desirable to reduce water levels in this area to enhance hydrologic restoration to the south and west. Our goal / target is to restore NSM conditions.

Recommendations

Develop a mechanism for reducing hydroperiods and water levels in the vicinity and downstream of the new S-190 pump station by moving the water south and west into areas still showing drainage effects.

Problem Identification

In the vicinity of the L-28 Tieback, there is still a small area of drained land in Alternative 5. Our goal / target is to restore NSM conditions.

Recommendation

It appears that removal of or breaks in the L-28 Tieback could benefit this area.

I. Water Quality Subregion

Neither the Lake Okeechobee Water Quality Model nor the Everglades Water Quality Model has been run (at the time of this writing) for Alternative 5. However, the Water Quality Team did review the design and operation of Alternative 5 components using water budget data output from the SFWMM. Furthermore, Dr. William Walker finalized his evaluation of alternatives 2, 3, and 4 under contract to Everglades National Park. Dr. Walker's work looks at the effect of an alternative plan, including the proposed design and operation of the EAA Reservoir (Component G) on the operation of the Everglades Construction Project and the downstream Water Conservation Areas. The Water Quality Team's review of Dr. Walker's evaluation is summarized below.

Performance Based Comments:

Alternative 5 created an increase over the 2050 Base condition in the volume of Lake Okeechobee water delivered to LEC Service Area 2 to meet water supply demands. A preliminary analysis of the partitioning of water deliveries to and through the Water Conservation Areas indicates that under certain conditions, water delivered from Lake Okeechobee to the Lower East Coast has the potential to increase phosphorus loads in the Water Conservation Areas.

Predicted hydroperiods in the Rockland Marl Marsh (south of lower leg of C-111 Canal) created by Alternative 5 fall short of preferred hydroperiods (see Florida Bay Coastal Basins report). The proposed West Dade 100 MGD Wastewater Reuse Facility could be designed and operated to augment hydroperiods in this area (delivery of treated wastewater to lower C-111 Canal and into Rockland Marl Marsh via recently-completed Mound Degrade Project).

Alternative 5 also created undesirable high water conditions in the southern part of Loxahatchee National Wildlife Refuge (Indicator Region 26). Water budget data indicate that

approximately 39 k acre feet (average annual volume) is delivered to LNWR from the Acme Basins (Wellington area). Acme Basins water consists of agricultural and urban runoff, which is presently untreated.

Water budget data for Lake Okeechobee in Alternative 5 continue to show that approximately 79 k acre feet of water from the Northern L-8 Basin is discharged to Lake Okeechobee. This is the same condition as the 2050 Base (discharges without treatment). Water quality data for the structures through which these flows pass indicate that Northern L-8 water contains relatively high concentrations of total phosphorus. Lake Okeechobee water discharges to the Everglades to meet hydrologic targets and to the LEC through the Everglades create performance problems for ECP (in the case of increasing lake flows to the ECP over the design flows) and increase phosphorus loading in the Everglades.

Water budget data for Lake Okeechobee indicate that Alternative 5 increases environmental water supply to the Everglades by approximately 61 k acre feet over the 2050 Base condition. These deliveries create an increased water load to the ECP and increase the net phosphorus load to the ECP. This could lead to performance problems in the STAs unless it is assumed that Phase II supplemental technologies are capable of treating additional flows and loads to meet the ultimate numeric phosphorus criterion. Restudy flows and loads exceeding the 2050 Base condition must be treated to assure that the ECP continues to achieve the final numeric phosphorus concentration criterion. The Water Quality Team is evaluating the incremental increase Restudy flows and loads deliver to the ECP and will be estimating potential costs associated with the supplemental technology designs for the ECP contained within the *Desktop Evaluation of Alternative Technologies Final Report*, 1996, prepared for the South Florida Water Management District by Peer Consultants and Brown and Caldwell, Joint Venture.

Performance Measures Used (South Florida Water Management Model):

1. Stage Duration Curves and Stage Hydrographs for all of the reservoirs included in this alternative plan (North Reservoir, Taylor Creek/Nubbins Slough Reservoir, St. Lucie Reservoir, Caloosahatchee Reservoir, EAA Reservoir, Site 1 Reservoir, C-11 Reservoir, C-9 Reservoir, Central Lakebelt Reservoir, North Lakebelt Reservoir, Bird Drive Reservoir).
2. Report, Lake Okeechobee Water Budget.
3. Water budget data from FTP site.

Performance-Based Recommendations:

1. Given the potential for increased phosphorus loads associated with water supply deliveries from Lake Okeechobee to the LEC to create ecological impacts in the Everglades marsh, the Water Quality Team recommends that alternative sources of water to meet LEC SA2 demands be investigated (e.g. wastewater reuse in Broward County).
2. Given the observed hydroperiod shortages in the Rockland Marl Marsh, the ecological effect of the additional water produced by the proposed West Dade Wastewater Reuse Project should be modeled in Alternative 6.
3. Given that water depths in southern LNWR exceed that predicted by the NSM, the team recommends that the hydrologic effect of re-directing Acme Basins discharges be evaluated by the Restudy Team (e.g. redirected to the LEC, or redirected to WCA 2 after treatment).

4. The Water Quality Team has identified several options for treating or redirecting Northern L-8 Basin water: 1) treatment of water prior to backpumping to Lake Okeechobee to reduce in-lake phosphorus loads and subsequent downstream loads to the ECP and the EPA; 2) creation of additional storage; and 3) routing a portion of Northern L-8 Basin flows south to LNWR via a flow-way or through STA-1E to meet hydrologic targets in northern LNWR.

General Recommendations:

1. The storage reservoirs should be operated to optimally capture phosphorus contained in inflows and remove phosphorus from outflows. To the extent that phosphorus is a surrogate for other pollutants, optimal operation of these facilities for phosphorus removal will contribute to additional downstream pollution load reductions. The team's present recommendation for optimal operation is to maintain at least 2.50 ft depth in the reservoirs, with a minimum hydraulic retention (residence) time of 21 days prior to discharge upon re-wetting (when depths fall below 2.50 ft). Stage duration curves and hydrographs should be produced for the new STAs/storage areas included in this alternative (e.g., Caloosahatchee STA, both Lakebelt storage areas).
2. An ad hoc Restudy issue team should be created to evaluate the projected increase in average water loads to the ECP, and make further recommendations regarding the effect of the projected increase on STA design and operation. In particular, the implications of the increased volume on the Phase 2 treatment requirement should be evaluated. The STA Design Group, Everglades Technical Advisory Committee, or technical staff in support of the Technical Oversight Committee established by the Settlement Agreement could facilitate this evaluation.
3. The modeling team should finalize the proposed performance indicator summarizing average annual structural and non-structural flows into and out of the Everglades Protection Area. The Water Quality Team views this as a particularly important indicator of potential water quality impacts associated with each alternative plan; such a performance indicator would also clarify potential land use conflicts and treatment costs.

Subteam Issues:

1. Restudy components must meet State and Tribal water quality standards, as appropriate. In particular, increased flows to the Everglades Protection Area (over that which is in the 2050 Base condition, i.e. Everglades Forever Act fully implemented) must meet the yet-to-be-established numeric phosphorus criteria for the EPA (default concentration = 10 parts per billion). The technology (and hydrologic demands, if any) required to achieve this standard has not yet been determined. Furthermore, it can be reasonably assumed that the technology (and concurrent land and hydrologic demands) will vary for Restudy components, depending upon location. Component design should continue to take into account current and future land uses in the vicinity of the components and the estimated land acquisition, construction, and operations costs to assure that water quality treatment facilities necessary to meet water quality standards are included in the final design.

Additionally, treatment costs may not be limited to just those necessary to achieve surface water standards. Restudy components capable of polluting ground water (ASR, discharges in the vicinity of underground drinking water sources) must include treatment necessary to

achieve ground water quality standards prior to introduction of discharges into the ground water.

2. The team does not expect to observe a recovery of Lake Okeechobee during the simulation period for the model(s). Therefore, the long-term benefits of treatment facilities and wetlands restoration in the lake watershed are not readily observable in the water quality performance indicators which are available to evaluate the affect of the Restudy on the lake. Although modeling results may lead the Restudy Team to empirically conclude that there are no observable water quality benefits achieved by including water quality treatment features in the Restudy components when compared to 2050 Base conditions, the Water Quality Team intuitively concludes that such projects and facilities will have long-term water quality benefits beyond the planning horizon for the Restudy.
3. Although the team concurs with the method for determining mean phosphorus concentration values in the Taylor Creek/Nubbins Slough basin (528 ppb), additional information is needed about the design and operation of the STA proposed for that basin. While it is understood that more detailed information about the design and operation of this component would occur in future detailed design work if this component is included in the final comprehensive plan, it is noted that the STA is assumed to achieve an 80% reduction in basin loads and concentrations prior to discharge to Lake Okeechobee (this efficiency is at the upper end of the range of phosphorus reduction efficiency for STAs).

Furthermore, the team has not determined that 107 ppb is the correct target concentration for discharges to Lake Okeechobee (this concentration will not necessarily contribute to a reduction of ambient lake water column phosphorus concentrations below the current mean concentration of approximately 100 ppb; the Lake Okeechobee SWIM Plan update indicates that 40 ppb is the target in-lake concentration). Additional treatment works may be necessary to achieve target concentrations.

4. Components K4, X3, and Y3 involve increasing the amount of water contained within the West Palm Beach Water Catchment Area. This involves collecting runoff from the L-8, C-51, and C-17 watersheds (Class III waters), and directing it via the M-Canal and C-18 Canal to the Catchment Area. The C-18 Canal, M-Canal, the Catchment Area and Lake Mangonia are all Class I waters (Potable Water Supply). To receive water quality certification under the Clean Water Act, Restudy components which create new surface waters discharges into Class I waters would have to discharge water of sufficient quality to assure that the Class I use classification is maintained. To further evaluate future treatment requirements, if any, ambient pollutant loads and concentrations within the watersheds would have to be quantified and compared against minimum, general, and Class I surface waters criteria contained within Florida Administrative Code Rule 62-302.
5. Components D5 and GG4 involve storing Lake Okeechobee and Caloosahatchee River watershed runoff in 122 10 MGD aquifer storage and recovery (ASR) wells, creating a total of 1,220 MGD of surface water to be injected and stored in the Floridan aquifer. These components create significant hydrologic benefits, especially in the lake. However, there are some troubling assumptions about Lake Okeechobee and Caloosahatchee ASR as presently

modeled. Particularly, the technical feasibility of injecting and a 70% recovery of 1,220 MGD has not yet been proven, nor has ASR on this scale been implemented anywhere that the team is aware of. Second, no treatment is assumed to be necessary prior to injection. This assumption is not consistent with current regulations for injection of water into potential underground sources of drinking. At a minimum, the cost for at-the-wellhead treatment should be estimated and added to the cost of the ASR component for Lake Okeechobee to more conservatively calculate the potential cost of this component. Third, the water quality and ecological impacts of recovering water stored in the aquifer and discharging it directly to Lake Okeechobee (Class I waters) and Caloosahatchee basin waters (Class III waters) have not been reasonably evaluated. The team has been made aware that the potential impacts include increased production of methyl mercury, changes in pH and temperature, and the introduction of water containing low-to-no dissolved oxygen. Water which is recovered from ASR wells may require additional treatment (e.g., wetlands) prior to discharging to Class I (Lake Okeechobee) and Class III (Caloosahatchee basin) surface waters to maintain the use classifications and ecological integrity of those waters and downstream receiving waters. Further detailed evaluation of ASR water quality and its impact on surface waters is necessary. An ad hoc ASR Team is being created for such a purpose. However, since it may not be possible to complete such an evaluation given the schedule for drafting a feasibility report and a PEIS for the Restudy, the Restudy Team should consider including additional treatment facilities and costs in the comprehensive plan to achieve and maintain water quality and ecological targets in Lake Okeechobee and Caloosahatchee basin waters potentially affected by ASR water.

6. Component DDD5 involves discharging Caloosahatchee basin runoff through an STA into Lake Okeechobee. New discharges to Lake Okeechobee must meet Class I drinking water standards.

ALTERNATIVE 5 COMPONENTS WQ ANALYSIS

Component Error! Bookmark not defined.	Source Water	Class OFW	[P] ppb	Receiving Water	Class OFW	[P] ppb	Storage Volume	Error! Bookmark not defined.Tre atment Efficiency/ Regulatory Reqments	Notes Hydrolog Performa
A5 North Res.	Lake O. Kiss. WS (?)	I III N	?	Lake O.	I N		200,000 af	?	Dry 60% o time; (Alt dry 75% o time)
B2 St. Lucie Res.	Lake O. St.L WS	I/III N	100 ?	St. Lucie River	III N		40,000 af	?	Below 2 ft 90% of tin dry 50% o time; Alt 4 stages fall faster from max depth
C1 St. Lucie Est. Deliveries	Lake O. St. L. Res.	I/III N	100 ?	St. Lucie Estuary	II/III Y			0 (Lake O.) ? (res.)	
D5 Caloos. Res.	Lake O./ Caloos. WS	I/III N	100 ?	C. River	I/III Y		160,000 af	C. Riv. In Lee Co. is Class I	Below 2 ft 50% of tin dry 30% o time.
D5 Caloos. ASR	Lake O. Caloos. WS	I/III N	100 ?	C. River (estuary)	I/III		220 MGD = 246,400 af	0 any treatment prior to ASR?	UIC regs apply to ASR. Mu year capability.
DDD5 Caloos. Backpumpi ng STA	Caloos. WS	III N	?	Lake O.	I	40	5,000 ac STA	Ambient P conc. unknown.	STA water should be delivered t Lake O to achieve P targets in SWIM pla
E5 Caloos. Est. Deliveries	Lake O. Caloos.	I/III N	100 ?	Caloos. Estuary	III/II Y				

	Res.								
F3 Lake O. Reg Schedule	Lake O.	I	100	St. L & Caloos. Rivers, EAA, WCAs.	I/III	10		Alt 5 E- glades water supply increases ~ 61 k ac. ft. over 2050 base	No add'l \ Benefits assumed from Reg. Schedule; potential impact on ECP

Component Error! Bookmark not defined.	Source Error! Bookmark not defined. Water	Class OFW	[P] ppb	Receiving Water	Class OFW	[P] ppb	Storage Volume	Error! Bookmark not defined. Treatment Efficiency/ Regulatory Requirements	Notes Hydrology Performance
G5 EAA Reservoirs	Lake O EAA runoff	I/III/ V(?) N	100 120	EAA WCA 3 (via STA 3/4)	III/ V N	10	3 @ 20,000 ac = 360,000 af		EAA > 2 ft 70% of time Glades A > ft. 35% of time; Glade below grou surface 40% of time.
H5 E-glades Rain-driven Operations	ECP/ STAs	III N	10	WCAs	III Y (ENP)	10		Increases flows through ECP.	Flows to El uncontrolled check water budget for ECP.
I3 Not included in Alt. 5									
J Not included in Alt. 5									
K4 L-8 Project	L-8 Basin, C-51 Basin, C-17 Basin	III N	?	M Canal, WPB CA Lox. Slough Lake Mangonia	I Y		25 MGD ASR= 28,000 af	Water must meet Class I stds.?	STAs included;
X3 C-17 B-pumping	C-17 WS	III N	?	M Canal, WPB CA (via STA)	I		STA = 1,800 af (Alt 3 = 2,200 af)	?	No hydrolo specs on S1 STA must achieve Cla I wqs
Y3 C-51 B-pumping	C-51W WS	III N	?	WPB CA	I		STA = 2,000 af (Alt 3 =	?	No hydrolo specs on S1 STA must

							2,400 af)		achieve Cla I wqs.
L3 Coastal Wellfields	GW							N/A	Operational change; includes Riviera Bch Dania, Miramar, Broward Co 3A. GW req apply.
M4 Site 1 Res.	Hills. Canal	III N	?	Hills. Canal WCA2A	III N	? 10	9,960 af	WCA 2A = 10 ppb	How much discharged WCA 2A? Res. below ft. 55% of time.
Error! Bookmark not defined.Error! Bookmark not defined.Co mponentEr ror! Bookmark not defined.	Source Water	ClassEr ror! Bookma rk not defined. OFW	[P] ppb	Receiving Water	Class OFW	[P] ppb	Storage Volume	Treatment Efficiency/ Regulatory Reqments	NotesErr Bookma not defin Hydrolog Performa
M4 Site 1 ASR	Hills. Canal +	III N	?	Hills. Canal	III N	?	75 MGD ASR to improve efficiency ; = 84,000 af (Alt 3 = 25 MGD ASR)	Injected water must meet primary drinking water stds.	100 % recovery assumed.
N2 WCA 2B Levee Seepage Manageme nt	WCA 2B								Not includ in Alt. 5
04	WCA	III	10	Indirect to	III	10			Buffer ma

WCA3A/B Levee Seepage Managem nt	3A/B	N		ENP via Lake Belt SA.	Y				Seepage v = WCA seepage w Buffer adj U.S 27. WCA3A seepage to go to Lakebelt no return S-9.
P2									Not includ in Alt. 5
Q5 W C-11 Diversion Canal & Impoundm ent	W C- 11 WS	III N	?	N Lakebelt Reservoir	III N	?	1,600 ac. STA/ Impoundm ent		N. Lakebe Res. (XX: delivers water to Broward- Dade Can
R4 C-9 STA/ Impoundm ent	N. Lakebe lt Res.	III N	?	C-9, C- 6/C-7, C- 2/C-4	III N	?	2,500 ac.; 10,000 af storage		Res. conta no surface water ~ 100% of time.
S5 Central Lakebelt Res.	WCA 3B	III N	?	L30/NES RD-B Lev. Canal S.Creek Canal C-6, C-9	III N Y(ENP)	? 11	5,200 ac. reservoir; +11 to 15 (26 ft. differential) . Up to 135,200 af	Polishing marsh (?) Impacts on NW Wellfield (?). Limestone filter (?)	Res. nearl full (+10 ft.) 50% o time.
T1 C-4 Structure	C-4	III N	N/ A	C-4	III N		N/A	N/A	WCA3B Seepage control

Component	Source Water	Class OFW	[P] ppb	Error! Bookmark not defined. Receiving Water	Class OFW	[P] ppb	Storage Volume	Treatment Error! Bookmark not defined. Efficiency/Regulatory Reqmments	NotesError! Bookmark not defined. Hydrolog Performan
Error! Bookmark not defined. U4 Bird Drive Recharge Area	WC-4 WS L-31N	III Y(L-31N)	? 10	C-4 Seepage to L-31N via S-356s	III N Y(ENP)	? 10	11,508 af Need to know what component is of lower wq	Seepage of adequate wq?	Below 7.2 100% of time; below 5.5 80% c time.
FF4 S-356 A&B	L-31N & Bird Dr. Res. seepage	III N	?	ENP	III Y	11	N/A	Treatment adequate/necessary? Increased P load?	Two 900 c pumps; direct discharge ENP (modeled sheet flow NESRS).
Error! Bookmark not defined. V2 L-31N Levee Seepage Mgt.	ENP	III Y	10	ENP	III Y	10	N/A (backpump wet season seepage)	N/A	
W2 T. Creek/ N. Slough Res/STA	T. Creek N. Slough WS	III N	528	Lake O	I N	100	50,000 af	528 107 ppb. Is this reasonable based on size, conc., & load?	100% of runoff less than 50,000 af treated STA. Res dry ~ 60% time; improved over Alt 4 (STA dry source?)
AA3	WCA	III	10	WCA 3B	III	10	N/A	Mod	Modeled a

Add'l S-345s	3A	N			N			Waters structures regulated under EFA.	sheet flow structures point source from 3A to 3B?
BB4 D-B Levee/ Pennsuko Seepage Control		III N	?	NW Wellfield	III (recharge canal) GW/DW	?	N/A	Treatment requirements to add incr. surface water to wellfield recharge canal?	Lakebelt STA adequate treatment to GW/DW stds.?
CC5 Broward Co. Canals	Hills. Canal; Basin runoff	III N	?	Canals, wellfields	III GW/DW	?	Quantify increased amount?	N/A	Increase canal size; pumping capacities recharge wellfields.
DD5 Holey Land Rainfall Operations	Lake O, Runoff, Rotenberger via STA 5/6	I III N Y	100 10	Holey Land WCA 3A via HPR features of ECP	III N	10		Lake O. deliveries treated via STAs? Rainfall target in H. Land	Need to know how much more Lake O. water is sent to ECP to provide Rainfall deliveries.
EE5 Rotenberger Rainfall Operations	STA 5	III N	10	Rotenberger; Holey Land	III Y	10		Rainfall target in Rotenberger. STA 5 is overloaded for design.	Increase in volume delivered by STA 5? Is capacity there?
GG4 Lake O ASR; same as Alt 3 except for operation Schedule.	Lake O	I N	100	Lake O	I N	DW	1,000 MGD 1,120,000 af	Fecal coliforms? Treatment required? Costs can be estimated?	More water available to lake during dry times.
HH3 S-343A & B Operational									Not included in Alt. 5

Change									
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Component Error! Bookmark not defined.	Error ! Bookmark not defined. Source Water	Error! Bookmark not defined.Cl ass OFW	[P] ppb	Receiving Water	Class OFW	[P] ppb	Storage Volume	Treatment Efficiency/ Regulatory Requents	Notes Hydrolog Performan
II3 G-404 Modification	STA 3/4	III N	10	WCA 3A	III N	10	N/A	Increased pumping to achieve HPR Goals.	Any dry-o impacts in STA?
JJ3 LNWR Rainfall Schedule									Not includ in Alt. 5
KK4 LNWR Internal Canal Structures	LNW R	III Y	10	LNWR WCA 2A	III Y N	10	N/A	N/A	Structures added to achieve hydrologic targets. A wq impact Canal wq : rainfall/m wq?.
LL4 C-51 ASR	C-51 WS	III N	? coli- form s?	C-51	III N	D W	270 MGD 302,400 af	Treatment required? to be injected into Biscayne; into Floridan	70 % recovery assumed; water to be injected = surface (C 51) water
MM4 Hillsboro Canal ASR	Hills- boro Canal	III N	? coli- form s?	Hillsboro Canal	III N	D W	185 MGD 207,200 af	Treatment required?	70 % recovery assumed; water to be injected = surface (Hills. Car water

NN3 North New River ASR									Not includ in Alt. 5
OO4 Phase II of Exp. Program	C-111 Basin, L- 31W	III N	?	ENP via S-332D into L- 31W	III Y (ENP)	10	N/A		C-111 Project; sa as Alt 3 except for pumps; potential v problems assoc. with increased dry-season flows from C-111 Bas to ENP.
PP3 C-7 Basin B-pumping	C-7 Basin								Not includ in Alt. 4

Component	Source Water	Class OFW	[P] ppb	Receiving Water	Class OFW	[P] ppb	Storage Volume	Treatment Efficiency/ Regulatory Reqs	Notes/Errors Bookmarks not defined Hydrologic Performance
QQ5 Decompart. WCA 3								WQ impacts associated with decomp? Redistribution of water column P. in 3B	Removed from 67A/C (weirs), Miami River and barrier between WCA 3B and ENP
RR4 Hydropattern impr. in WCA 3A (relocate S-140; incr. capacity)	L-28/L-28I	III	?	Central WCA 3A	III	10		Pumped redistribution of water column P.	WQ dependent upon S & Tribe water projects? Non-ECP structure?
SS4 Relocate Dade Co. Water Supply Deliveries									Miami Canal eliminated No adverse wq impact assumed.
TT4 Decompart. WCA 2									Not included in Alt. 5
UU5 C-23/24 Reservoirs	C-23/24, NF & SF WS.			St. L estuary			190,256 af	Nutrient fluxes?	Need hydrologic performance data.
VV5 Central PB Co. Reservoir + 75 MGD ASR	LWDD back-pumping			LWDD dist. system			9,960 af	Some wq benefits assumed? WQ treatment for ASR required.	Need hydrologic performance data.
WW5 C-111N	C-111 &	III	?	C-111N, triangle in	III N	?	Size of STA?	STA to be constr. in	Purpose to impr.

Spreader Canal	C-111E			Model Lands				triangle.	hydroperiod in S. Dade/Model Lands
XX5 N. Lakebelt Storage Area	C-6, C-11, C-9 WS	III	?	C-9 STA, C-9, C-6, C-7, C-4, C-2			4,500 ac; +5.0 ft. to 15.0 ft = 20 ft. differential; 90,000 af		Zero transmissibility assumed any potential impacts to NW Wellfield?
YY4 WCA2B flow diversion structures	WCA 2B	III	10	NESRS C. Lakebelt Sn. Creek D-B Levee	III	11 ? ? ?		WCA 2B water shouldn't cause downstream impacts	(3) 800 cfs structures from WCA 2B

Component Error! Bookmark not defined.	Source Water	Error ! Book mark not defin ed.Cl ass OFW	[P] ppb	Error! Bookmark not defined.R eceiving Water	Class OFW	[P] ppb	Storage Volume	Error! Bookmark not defined.Tre atment Error! Bookmark not defined. Efficiency/ Regulatory Reqments	Error! Bookma not defined.No Hydrolog Performa
ZZ5 Lake Belt WPA diversion	WCA 3A&& B	III N	10	Ce. Lake Belt SA (Compone nt S5)	III N	?	N/A	WCA water should meet wqs.	S5 water g back to EF and to E Coast Can
AAA5 LEC Water Conservatio n	N/A	N/A	N/ A	N/A	N/A	N/ A	N/A		17% reduction i demands from regio system.
BBB5 So. Dade Reuse	So. Dade WWTP	N/A	?	Biscayne Bay & Coastal Wetlands	III Y	?	402 af/day	Treatment sufficient to meet wqs for Biscayne Bay	Provides d season flo
CCC5 Big Cypress L-28I Modificatio ns	W & N Feeder Canals	III	?	Seminole Reservatio n; NE Big Cypress	? Y			STA to meet Sem. WQS. Where? Land use conflicts?	S-190 converted pump; L-2 backfilled of Sem. R
DDD5 Caloos. STA/ Backpumpi ng	C43 WS	III N	?	Lake O	I N	40	5,000 ac STA	STA must deliver water meeting Class I standards	Pumped discharge Lake O.
EEE5 WCA water to CLBSA to WCA 3B	WCAs 2B, 3A, 3B	III N	10	WCA 3B					Water delivered from CLB to WCA 3 via treatm

									wetland L-spreader swale
Total Available Storage, Alt 5							3,230,684af (incl. 1,750 MGD ASR)		Alt 2 = 988,606 af Alt 3 = 2,993,868 Alt 4 = 3,083,428

1 ac. ft. = 325,851 gallons; 1 MGD = 3.07 ac. ft.;

1 MGD annual volume = 1,120 ac.

LEGEND:

WS = Watershed

ASR = Aquifer Storage & Recovery

ECP = Everglades Construction Project

STA = Stormwater Treatment Area

WPB CA = West Palm Beach Catchment Area

D-B = Dade-Broward Levee

Y = Yes

N = No

W = West

WCA = Water Conservation Area

CSSS = Cape Sable Seaside Sparrow

af = acre feet

J. ATLSS / Threatened and Endangered / Keystone Species

Performance Based Comments:

An individual-based ATLSS simulation and Population Viability Analysis are available for the western sub-population of the Cape Sable seaside sparrow. Breeding Potential Indices (BPIs) are addressed for other Cape Sable seaside sparrow sub-populations and white-tailed deer. For wading birds, ATLSS produces a Foraging Conditions Index with separate analyses for "short-legged" and "long-legged" species. Outputs on total fish abundance and fish prey base for wading birds are also available. Differences in inputs and methods make comparisons of Alternative 5 results to other alternatives difficult in some cases. Performance indicators for Cape Sable seaside sparrows and American crocodiles are also addressed.

Performance:

Fish

The ATLSS fish model predicts that Alternative 5 hydrologic conditions will produce average fish abundances consistently higher than those expected for 2050 Base, particularly in NE Shark River Slough, WCA-3B, WCA-3A south, Loxahatchee National Wildlife Refuge and WCA-2A. This is also true when only prey-sized fish at appropriate wading bird foraging depths are counted. Exceptions occur in WCA-2B, northeastern WCA-3A, East Slough and South Big Cypress, where Alternative 5 produces slightly lower fish densities than the 2050 Base. Alternative 5 results are very similar to Alternatives 2-4, with very slightly higher average densities for Alternative 5.

Wading Birds

In the Eastern rookeries (eastern WCA-3A, WCA-3B and NE Shark River Slough), on average, Alternative 5 predicts slightly lower foraging condition values than the 2050 Base for short-legged wading birds and mixed results (leaning toward lower values for Alternative 5) for long-legged wading birds.

In the historic Shark Slough/mangrove estuary interface rookeries, for short-legged wading birds Alternative 5 predicts higher foraging condition values than the 2050 Base in south Taylor Slough, East Slough and scattered sites in Big Cypress and lower values than the 2050 Base for the main Shark Slough drainage where a majority of the traditional rookeries are located. For long-legged wading birds, Alternative 5 produced equal or marginally higher values than the 2050 Base.

Changes in input data make comparison of Alternative 5 results to other alternatives difficult.

White-tailed Deer

Alternative 5 would slightly improve the generally poor breeding conditions for white-tailed deer in SE Big Cypress, NW ENP, SE ENP, Holey Land, Rotenberger and WCA-2B as compared to the 2050 Base, particularly in years with average to above average rainfall. Alternative 5 would slightly decrease the very low breeding potential in NE Shark Slough and WCA-3B as compared to the 2050 Base. For those few areas with high deer breeding potential (Long Pine Key and surrounding short hydroperiod marsh and NW Big Cypress), there is little difference between Alternative 5 and the 2050 Base. These results are similar to Alternative 4 except for increased breeding potential in WCA-3B under Alternative 5.

Cape Sable Seaside Sparrow

In the western subpopulation area, the 1995 Base and Alternative 4 produce dry conditions at about three weeks earlier than Alternative 5 and Alternative 5 re-floods the area a few days earlier than Alternative 4. Alternative 5 produced lower breeding potential in all areas as compared to Alternative 4. Alternative 5 produced slightly improved breeding potential in the western subpopulation area, and lower breeding potential in the core and eastern subpopulation areas as compared to the 2050 Base. The ATLSS individual-based sparrow simulation is applied only to the western sub-population, and predicts persistence of this sub-population under alternatives 3, 4 and 5. Alternative 5 produced lower population levels and a greater risk of extirpation than alternatives 3 and 4. A Population Viability Analysis using the individual model predicts that the western subpopulation will be less likely to remain above minimum numbers and reach or exceed maximum numbers under Alternative 5 than under alternatives 3 and 4.

American Crocodile

Performance measure outputs are now available. Alternative 5 is the best yet for crocodiles, with reductions in the time habitat experiences salinities >40 ppt and some improvements in time spent at lower salinities. These results are better than those for the 2050 Base and 1995 Base, but do not yet reach the lower salinities predicted by NSM.

Performance Measures and Indicators Used:

1. Breeding Potential Indices for the Cape Sable seaside sparrow and white-tailed deer.
2. Foraging Conditions index for long-legged wading birds and short-legged wading birds.
3. Fish productivity model.
4. Indicator region 46 - Cape Sable sparrow west.
5. ATLSS Cape Sable seaside sparrow Individual-based Simulation.
6. ATLSS Cape Sable seaside sparrow Population Viability Analysis
7. American Crocodile Performance Measure

Recommendations:

1. Wading Birds - Bring down overly deep water levels in eastern WCA-3A and WCA-3B and reduce dry season reversals.
2. Cape Sable seaside sparrow - Bring hydrological conditions in the western subpopulation area back to Alternative 4 conditions and bring hydrological conditions in the core and eastern subpopulations areas back to Alternative 3 conditions.
3. American Crocodile - Increase flows to Florida Bay, particularly in dry years.

Subteam Issues:

1. The sparrow west indicator region shows that NSM predicts longer hydroperiods in the western sub-population area that would lead to further declines in the sparrow BPI. A similar situation may exist with NSM targets for Indicator Region 8, which encompasses the largest part of the sparrow's eastern sub-population. The subteam urges Restudy participants to reconsider NSM-based targets when biological information, such as sparrow breeding needs, suggests different targets.
2. Can the white-tailed deer BPI be combined with existing panther radiotelemetry data to get a rough index of the proportion of the panther's prey base that is predicted to be affected by the alternatives? The subteam suspects this will prove to be a small portion of the panther's prey base, but it would be a useful calculation if it can be done before June. The subteam will work on this.
3. The snail kite ATLSS model was not quite finished in time for the Alternative 5 runs. It will be available for Alternative 6.